

MONTHLY BULLETIN

OF THE

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

(ENGLISH EDITION)

PUBLISHING and EDITORIAL OFFICES : 231, RUE ROYALE, BRUSSELS.

Yearly prepaid subscription { **Belgium 70 Belgas** } including postage
 { **Other countries . . . 75 Belgas** }

Price of this single copy : 8 Belgas (not including postage).
 (1 Belga = 5 Belgian francs.)

Subscriptions and orders for single copies (January 1931 and later editions) to be addressed to the General Secretary, International Railway Congress Association, 231, rue Royale, Brussels (Belgium).

Orders for copies previous to January 1931 should be addressed to Messrs. Weissenbruch & Co. Ltd., Printers, 49, rue du Poinçon, Brussels.

Advertisements : All communications should be addressed to the Association,
 231, rue Royale, Brussels.

CONTENTS OF THE NUMBER FOR NOVEMBER 1938.

CONTENTS.	Page.
I. Tickets : Part H (<i>continued</i>) and Part I (<i>concluded</i>), by Lionel WIENER . . .	1079
II. Electrification of the Paris-Le Mans line of the former French State Railways, by J. DUMAS	1175
III. Steam locomotives for high speeds , by Karl GÜNTHER	1185
IV. NEW BOOKS AND PUBLICATIONS :	
Les tarifs actuels des Chemins de fer suisses pour le transport de marchandises agricoles et d'animaux (<i>Present-day Swiss railway rates for the transport of agricultural produce and livestock</i>), by G. HARTMANN . . .	1193
Cours d'exploitation des chemins de fer, Tome II : Exploitation technique — Signalisation (<i>Railway operating course. Vol. II, Technical operation : Signalling</i>), 2nd Edition, by U. LAMALLE	1194
V. OBITUARY : Sir Henry Fowler	1195
VI. MONTHLY BIBLIOGRAPHY OF RAILWAYS	1197

LIBRARY
OF THE
Permanent Commission of the International Railway Congress Association.

READING ROOM : 231, rue Royale, Brussels.

Works in connection with railway matters, which are presented to the Permanent Commission, are mentioned in the « Bulletin ». They are filed and placed in the library. If the Executive Committee deems it advisable they are made the subject of a special notice. Books and publications placed in the reading room may be consulted by any person in possession of an introduction delivered by a member of the Association. Books, etc., may not be taken away except by special permission of the Executive Committee.

The Permanent Commission of the Association is not responsible for the opinions expressed
in the articles published in the Bulletin.

All original articles and papers published in the BULLETIN are copyright,
except with the consent of the Authors and the Committee.

Editions in French and in German are also published.

BULLETIN
OF THE
INTERNATIONAL RAILWAY CONGRESS
ASSOCIATION
(ENGLISH EDITION)

[656. 234]

Tickets,

Continued ()*

by LIONEL WIENER,
Professor at the University of Brussels.

PART H.

THE PHYSIOLOGY OF TICKETS.

(Continued.)

CHAPTER XVI.

COLOURS.

Owing to the impracticability of printing ticket reproductions in colour, we all distinguish between the colour of the card on which black or colour printing will subsequently appear and which will be dealt with in paragraph 3 of Chapter XVII, and any overprints which may further be added (Par. 4, same Chapter).

1. *Colour of tickets.* — The choice of colours is important. They must be easily distinguishable, not only by daylight but also by artificial light. The colours of multi-coloured tickets must not blend; they should rather tend to contrast; kindred shades are apt to give the ticket an indistinct appearance and all possibility

of confusing one colour with another should be avoided.

« Warm » colours or, as the printing trade calls them, colours that « sing » should always be used. In certain countries such as Austria, Hungary and the Balkans, the hues are usually too dull.

The colours must take the printing well; they should be fast, without any tendency to fade or change. For this reason, violet or mauve, which are particularly affected by sunlight, are usually ruled out.

White is easily soiled and tends to turn yellow when stocked, but from our standpoint this is a small matter. In practice, printing in white being difficult, only the coloured portions are printed, leaving white portions of the base showing.

It should not be forgotten that if one

(*) See *Bulletin of the Railway Congress*, March, May, July and September 1938, pp. 217, 3, 665 and 893 respectively.

colour be printed over another, the appearance of either can be altered, which gives rise to unexpected effects on multi-coloured tickets. Thus the aspect of a coloured band can be quite different according to the colour of the part of the ticket on which it is printed; the portion of a yellow band printed across a blue, white and pink ticket will appear green, yellow and brown respectively.

Different colours or combinations of colours are frequently used to distinguish between various classes and categories. Whereas it is easy to discern any one of these types, this would hardly be possible when there is a riot of multi-coloured tickets which tend to general confusion. However pleasing they may be, the colours formerly used by certain English lines such as the *London, Brighton and South Coast Ry.* and most of those of Eire, form a striking example.

The various categories, classes and direction of travel, are indicated by colour. The « International Convention » on the one hand, and understandings between British railways on the other, have standardised the following colours for normal tickets :

1st class	Yellow.	White.
2nd class	Green.	Blue.
3rd class	Brown.	Buff or green.
Dogs	—	Vermilion.
Various	—	Orange.

German 4th-class tickets were grey. Numerous English Companies had different sets of colours for local and through interline tickets.

BI-COLOURED TICKETS. — The colours may be arranged transversely, longitudinally or diagonally (*figs. 456, 489, 491*). Using two shades of the same colour is unadvisable. White is often employed instead of one of the colours, as it is contended this gives the ticket a neat ap-

pearance and lowers printing costs. The first reason is a good one and the type stands out better. The second reason is less sound, as printing a portion instead of the whole ticket is no saving. Besides, colours are available which give a bi-coloured effect to a partly coloured ticket.

Superiority of class may be denoted by one of the colours while the other remains constant. The latter used to be yellow in France; it is now white, which comes cheaper as the number of colour printings is reduced from two to one.

Both single and return tickets can be bi-coloured. The colours of the two portions of returns were not always chosen arbitrarily and could indicate the direction of travel.

Edmondson excess tickets between fixed points were usually coloured according to the two classes concerned. In other cases, bi-coloured tickets used to indicate certain special rates. In France, half-fare tickets are divided longitudinally and quarter-fare military tickets, diagonally (*fig. 456*). In Germany, transverse division of colour indicates a military ticket.

On Edmondson coupon tickets, certain divisions are made either across the whole of the ticket or on each coupon (*figs. 480, 590, 591*). The « International Convention » (C. I. V.) prescribed that return tickets should bear a longitudinal white band, 3/8" wide. German Sunday tickets have a similar band, but in azure.

Children's tickets often have a white border, 1/8" to 3/8" wide along the smaller side.

OTHER ARRANGEMENTS OF COLOURS ON EDMONDSON TICKETS. — The tickets of a few Companies have a 3/16" border all round. This is generally red, the centre being of the usual colour. Printing the border



Markings and colours of Edmondson tickets. (Red. 4/5).

Fig. 587. — Return ticket, *Netherlands Rys.* — White borders, distinguishing marks.

Fig. 588. — *Czechoslovakian State Rys.* single ticket — Coloured borders.

Fig. 589. — Roll ticket with colour hatching — *Dutch East Indies Rys.*

Fig. 590. — Three-coupon blank return ticket — *French Nord Ry.* — Category : Military.

simply adds another ⁽¹⁾ (figs. 121, 169, 626).

Some other French, Austrian or Netherlands lines print coloured triangles in each corner of their white or coloured tickets, the colour of these triangles being the index of the category. The advantage of proceeding in this way lies in the fact that the letterpress shows up very clearly on the body of the ticket (fig. 206).

A simple square in a second colour in a fixed spot of Edmondson tickets may also be used (fig. 587). About 1900, the *Est Ry.* showed the class of carriage in this way.

When travelling takes place in two different classes, the latter are used in the reverse order when returning. This is

shown on both halves of Edmondson return tickets which then look like a section of a chess board.

MULTI-COLOURED EDMONDSON TICKETS are seldom used outside England ⁽²⁾. Their surface is equally divided into three, at times four colours, which may even be repeated in the same or the reverse order on each of the two portions of return tickets. Some road transport tickets have the same arrangement of colours to enhance their divisions. Outside the British Isles, the most striking examples are to be found in Indo-China ⁽³⁾.

Special markings. — A glance over the illustrations shows their variety; certain of them have a special meaning.

(1) Paris *Ceinture Ry.*, French *Est Ry.*, *Prince Henri Ry.* (Luxemburg).

(2) The following examples are to be met with :

Reddish brown, brown, emerald (*Cambrian Rys.*), light brown, pink and green (*Bishop's Castle Ry.*)

Yellow, black and red on the back of platform tickets of the *Beira Alta Ry.*

On soft cardboard tickets : white, pink, yellow and green (*Manchester*); white, pink, blue and yellow (*Johannesburg*), as well as in *Jugoslavia*, *Switzerland* and the *Netherlands*. At *Johannesburg*, each colour corresponds to a different fare (3 d., 6 d., 9 d., 1 sh.), at *Manchester*, to a day of the week (fig. 283).

(3) The tickets are divided longitudinally in two bands, one 3/8", the other 1 3/16" wide and into two or three portions vertically. All combinations of white, golden yellow, blue, grey, violet, orange and green in bright colours occur.

Stars denote party tickets on Continental booklets; in Great Britain and on British Railways overseas, circles and squares are used to designate special categories of return tickets (figs. 334, 623). Other markings such as circles, rings and stars (figs. 303, 164, 301), lozenges, crosses (figs. 505, 589) and even more complicated designs are to be found as well (figs. 593, 594).



Fig. 591. — Military return two-portion ticket each bicoloured half being diagonally divided. (Red. 4/5) — French *Est Ry.*

Fig. 592. — Return ticket with different coloured markings on each half, and outline letter denoting category — *Great Southern Rys., Eire.* (Red. 4/5).

A longitudinal STRIPE down the centre of the ticket means that it is good on all trains (figs. 201, 418).

Thin coloured stripes, whether vertical, horizontal, diagonal or crossed, arranged singly or in groups, or repeated all over the ticket, are part of the printing and outside the scope of « colour » with which we are dealing (figs. 596, 188, 589). The same applies to bands from 3/16" to 5/16" wide (figs. 587, 592), which may even extend over the whole surface of the ticket (figs. 321).

Certain categories of British road transport tickets such as countermarks or exchange tickets often bear St. Andrew's crosses (fig. 282) which are frequently used to indicate the return portion of railway round-trip Edmondson tickets (fig. 339).

The usual width of COLOURED BANDS varies from 1/8" to 3/8", but they are



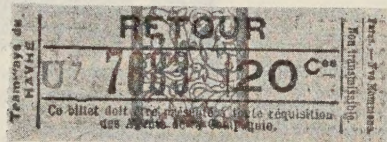
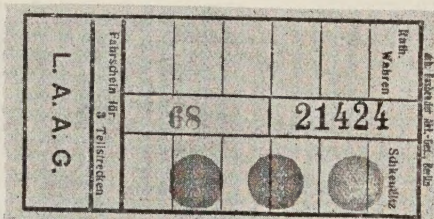
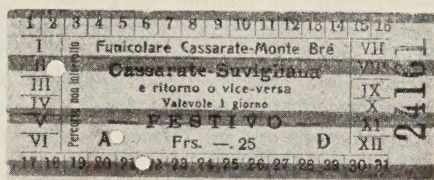
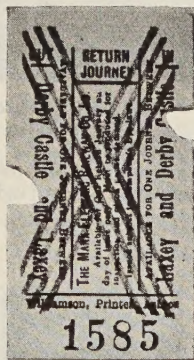
Figs. 593 and 594. — Distinctive markings neatly machine overprinted in a second colour — *Anglo-Chilian Nitrate and Rys., Co. Ltd.* (Red. 4/5).

occasionally larger and may even extend to cover the whole of the ticket with the exception of the borders. These bands may be symmetrical or not (figs. 427, 592); they may be entirely of one colour or of two successive ones.

The combinations are more numerous on tickets with detachable portions, for the bands, whether straight, crossed or diagonal, may be repeated on each one of them (fig. 177). On bi-coloured tickets, they are often in the second of the two colours. Occasionally, two differently coloured bands, each several millimetres wide, are placed alongside and

against each other (*Italian State Rys.*). They may be plain, skeleton or with reserves (*figs. 200, 198*). They may be made of dots, of close hatchings, or comprise a design with blanks in it (*figs. 368, 599*).

According to the position, borders may have special meanings. A single red or even white border along the short side often denoted the return half of Edmondson tickets (*fig. 228*). The German excess fare cards for travelling in the « Eilzüge » (ordinary fast trains) had lengthwise borders in the colour of the class.



Edmondson tickets with various markings. (Red. 4/5).

Fig. 595. — Platform ticket from an automatic machine — *French State Rys.* — Available for an hour — Prohibitory notices.

Fig. 596. — *The Manx Electric Ry., Co. Ltd.* — Return soft carton ticket.

The « Bireka » and « Numerus » firms issue tickets with a large variety of coloured borders (*fig. 563*). White Edmondson tickets with two longitudinal borders are used in Austria and Hungary. On the contrary, in the Netherlands, the coloured portion of the ticket does not reach the longitudinal edges, leaving two white borders along them (*fig. 587*). All the combinations of colours, bands, stripes and special markings can be ap-

Paper tickets with various coloured markings. (Red. 3/4).

Fig. 597. — *Cassarate-Monte Bre Cable Ry.* — Category : Festivities.

Fig. 598. — *L. A. A. G.* — The number of fare stages for which the ticket is available is indicated by coloured circles.

Fig. 599. — *Havre Tramways.* — With design in stripe denoting return journey.

Fig. 600. — *Botanical Gardens Railway, Rio* — Exchange ticket for an outward or return coupon — Illustrations on back. (See *fig. 643*).

plied to the back as well as to the front of Edmondson tickets (*figs. 622 to 624*).

THE COLOUR OF BOOKLET COUPONS corresponds with the class of travel. In some cases, a leaflet comprises two half-coupons for journeys in different classes,

over one of two alternative routes, these leaflets being in the colours of the two classes. The covers of the booklets are sometimes in two colours also. Child's paper coupons are sometimes divided ver-

are bright and vary according to the fare (fig. 631).

3. Reserves. — When printing the colour, it is easy to allow for reserves which

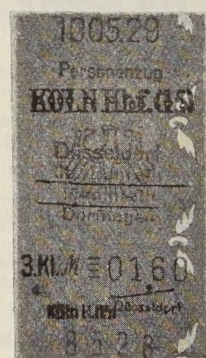
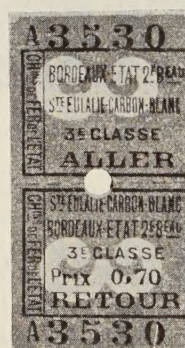
Fig. 601. — American semi-blank *Pullman* supplement. (Red. 3/4) — Lithographed in negative type — Category, date, number of passengers, seat number, method of payment, and fare in dollars and cents, indicated by perforation.

tically into two portions, the left-hand one being coloured according to the class while that on the right is white.

Dutch and German blank CARDS, 4 3/8" by 3 3/8", have a 3/8" border and grids printed in the colour of the class.

British through blank PAPER TICKETS are overprinted with distinctive coloured markings : ovals, losenges, rectangles or diagonals, these being single, double or treble according to the class.

The *Fasbender Printing Works* produce tramway paper tickets with the map of the system. To make them clear, they are printed on a white background, the tickets being coloured along the edges, either the long ones only when paid for in cash, or along the four of them when torn out of blocks of tickets. The colours



Edmondson tickets with white reserves in background. (Red. 3/4).

Fig. 602. — Figure denoting the class — French *State Rys.*

Fig. 603. — Winged wheel railway symbol in reserve — German *Reichsbahn* — Machine printed when issued, by means of two block — Overprinted German eagle.

will draw attention to certain points that should appear on the ticket without it being essential they should be read. Letterpress may be left in reserve, thus appearing as an underprint beneath the ticket's usual type-set printing. Actually, this is exactly the reverse process to the usual overprints, and has the advantage of enabling one to show certain particulars in an unobtrusive manner. This method is used on Edmondson tickets, for :

- The Company's name (fig. 605);
- Its crest or monogram (fig. 27);
- The railway winged wheel (fig. 603);
- Certain figures (class, fig. 602; number of the coupon, fig. 352);
- The destination (fig. 604).

When the two parts of return tickets are printed in two different colours, reserves on either half may advantageously be printed in the colour of the other (fig. 298); the same applies to bands and designs. When the bands extend over both halves, they may appear, on each half, in the colour of the other.

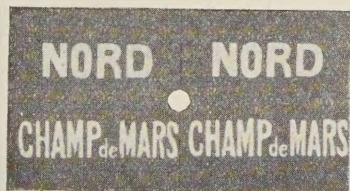


Fig. 604. — Nord Ceinture, Paris — Company's name and destination station.

Letterpress occasionally appears in white on coloured background. Both the Pullman Palace Car Co. and the American Pullman Co. had lithographed paper tickets of the kind where all the text that could be pre-printed showed up clearly. Further items were added by hand and

other data were clipped in appropriate lists (fig. 601).

CHAPTER XVII.

THE PRINTING.

1. **Printing processes.** — Typography in a single or several colours is generally used for the text and the maps of the systems, but other processes have also been called upon, ranging from occasional hand or type-written inscriptions (fig. 608) to the most high-class work.

Line- (figs. 277, 494), or half-tone blocks are frequently used, particularly when reproducing views (figs. 440, 556), the latter process having superseded the former heliogravure (fig. 270). More recently, lithographic and offset processes, and even engraving, have been resorted to.

Single-colour lithography is often beautiful as instanced by American one-fare cards (fig. 388) or paper coupons

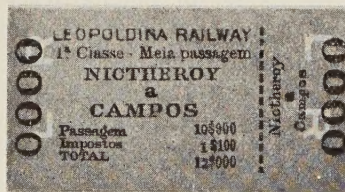


Fig. 605. — Initials of Leopoldina Ry., Brazil, in reserve — With check stub and appropriation of fare.

drawn on the lines of bond coupons (fig. 606). But it is little used now and is generally confined to background designs (fig. 586).

A number of tickets have been chromolithographed; we have necessarily had to reproduce them in black and white, which



Fig. 606. — Double one-fare coupon-elements.
(Red. 3/4) — Interstate Transit Co., East
St. Louis — One coupon for bus travel, the
other for bridge toll.

hardly does them justice (figs. 213, 500, 575, 640). Used down to 1894 when the interior railway of the Lyons Exhibition got its set of picture-tickets out (fig. 213), it has been revived in America where, moreover, it had all along been used for free passes. Figure 341 shows an exceptionally fine example of the older three-colour work, but it is now confined to backgrounds of weekly or multi-trip passes (fig. 344).

Besides these, the guilloche background of American tickets is often lithographed in one, exceptionally in two colours (figs. 434 and 437), as is also the entire face of many of the European elementary value-coupons (fig. 401).

Offset printing has supplanted it within the last few years — it cannot be said to have replaced it. Offset is widely used for American weekly passes and trip-

tickets (figs. 309-310). Coloured tickets issued elsewhere for special occasions such as the *International Railway Congress* members' passes (fig. 314), or the special paper tickets commemorating the opening of certain Japanese lines (fig. 568, Tokyo, fig. 607, Kobe), are also offset printed.

After having produced some of the finest specimens of tickets, relief processes tend to die out entirely.

The Companies' crests or coats of arms are still occasionally stamped, sometimes in gold and several colours, but apart from them the only cases now to be met with are the Companies' names or initials on American passes. Dry stamping is largely used, especially in Europe, for printing the Company's crest on many classes of paper and Edmondson tickets which are thus validated, and dry date-stamps print a number of figures and of letters on most European and overseas Edmondson tickets (fig. 452).

But the most artistic tickets of all were line-engraved by bank note printers and the fact of their having existed at all will have come as a surprise; we have pre-



Fig. 607. — Kobe Municipal Tramways commemorative ticket printed in four-colour offset for the opening of a new line. (Red. 3/4).

viously quoted a number of instances ⁽¹⁾. In Europe, the *Great Western Ry.* alone still prints line-engraved season tickets (*fig. 326*), while certain American Companies have retained the process for their free passes, either for printing the title, the crest, views of the system, or pictures of their rolling and floating stock.

Finally, we should quote perforation printing (*figs. 93, 160*) or punching (*fig. 620*), of figures and letters, which we have dealt with elsewhere.

2. **Type. — CAPITALS.** — When initials of well known places stand out clearly, it is frequently possible to guess accurately the rest of the station names, especially when seen frequently with the same spacing between the wording. This is why some Railways and a number of road transport Companies use initials of heavy type belonging to another fount and larger than the lower case type of the text ⁽²⁾ (*fig. 652*).

Capitals are seldom used for the whole of the printed matter, though this was occasionally done at first, particularly for the setting out of notices; it was thought — erroneously — that this would draw the holder's attention to them and get the passenger to read and memorise them.

FANCY TYPE is little used save to provide alphabetical designation of tramway and bus routes and for overprinted initials on British road transport tickets (*figs. 448, 532*). Dotted letters are used on some Dutch road transport tickets, whilst Russian serial letters appeared, strangely enough, on the oldest *Malaga Tramways* tickets (*fig. 609*).

OPEN OR SKELETON TYPE is frequently used for over- or under-printing as it is easy to read ordinary text through it. In Great Britain, skeleton letters indicate the class (category) of ticket (*fig. 592*), the return portion of round trip tickets (*figs. 164, 179*), the destination or exchange station (*figs. 164, 165*). Open numerals are used for the fare (*figs. 203, 206, 288*), the number of days of availability, the number of the class, the number of the station (*fig. 201*) or zone (*fig. 206*), and for the date (*fig. 630*).

When card or paper tickets bear complete designs or drawings, outline numerals or letters are worked in.

GOTHIC TYPE was only used on Edmondson tickets, for the Company's title or its initials (*fig. 156*) ⁽³⁾. It is still to be found on a few British (*Nottingham Corporation*) and several German road transport Companies.

(1) Thus, in the early eighties the *American Bank Note Co.* produced the fine tickets of the *Bahia Tramways* (*fig. 274*). The *Hamilton Bank Note Co.* and the *Western Bank Note Co.* engraved trip-coupons (*figs. 390, 391*), and the *National Bank Note Co.*, a number of splendid free passes such as the *Erie's* which we have reproduced, *figure 331*. Others furnished multi-trip cards as those of the *Illinois Central*, whose engraving has not been surpassed for finish or design (*fig. 342*).

Engraved tickets are scarce outside America. We have quoted the elementary travel-coupons which the *New South Wales Govt. Rys.* used on their Sydney tramway lines (*fig. 363*), and the hollow tickets engraved by Devambez for a boat service of the Paris 1900 Exhibition (*fig. 561*).

(2) The *London, Brighton and South Coast Ry.*, the *Metropolitan* and *District Rys.*, London.

(3) This was also done by British Companies abroad. Thus *S. B. R. G. S.*, in Gothic type, referred to the *Southern Brazilian Rio Grande do Sul Ry. Co.*

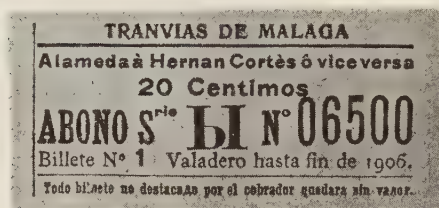
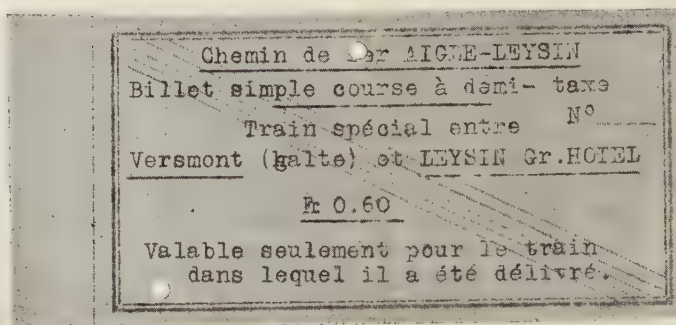


Fig. 608. — Emergency paper typewritten stencil ticket of the *Aigle-Leysin Ry.* (Red. 3/4).

Fig. 609. — *Malaga Tramways* paper ticket with serial letter in Russian type in text. (Red. 3/4).

Fig. 610. — *Pere Marquette Ry.* card ticket — Marked « made in U. S. A. ». (Red. 4/5).

Certain obsolete Edmondson tickets show an occasional old English capital which has been slipped among standard Roman lettering so as to constitute so-called secret signs (Chapter XI, *fig. 441*).

NEGATIVE TYPE brings out a word, a figure, or a portion of the text and fulfils the same function in regard to the letterpress as do « reserves » in colour printing. Thus negative type is used for printing, on Edmondson tickets :

- The Company's arms (*fig. 151*);
- Its title, especially in America (*fig. 81*);
- The caption « See back » or its equivalent in the British Isles;
- The word « stub » in America (*fig. 271*);
- The words « going » or « return » or their equivalent in various languages (*figs. 180, 337*);

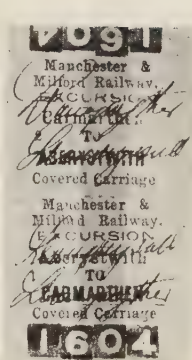
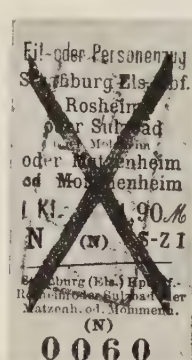
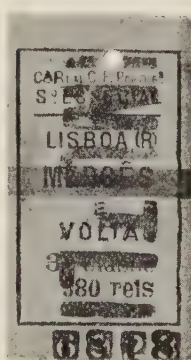
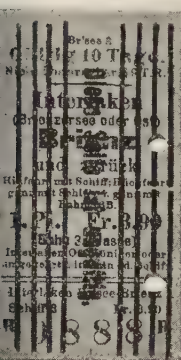
The category, « half » in Austria, « child » in Norway, etc.;

The name of either of the end stations (*fig. 266*);

The class of carriage (*fig. 79*);

The number of the ticket on many Anglo-Saxon Railways (*figs. 80, 178*).

Negative type frequently appears on paper tickets and in advertising matter (*fig. 256*). When using negative in conjunction with ordinary type, lists become clearer and the number of punchings or nippings may be halved. This is done by printing the left-hand portions of all the listed names in ordinary, and their right-hand portions in negative type, or vice-versa. According to the side punched, the clipping applies to opposite ele-



Machine-cancelled Edmondson tickets with new printing on the other side. (Red. 4/5).

Fig. 611. — *Swiss Federal Rys.* — Caption « This side is not good ».

Fig. 612. — *Portuguese Rys. Co.* — Ticket cancelled because the word « Royal » appeared in the Company's name.

Fig. 613. — *Alsace-Lorraine Rys.* — Cancelled during the War and reissued with new printing.

Fig. 614. — Old ticket of the *Welsh Manchester & Milford Ry.*, issued about 1860 — Both the departure and destination stations have been altered in writing — Category : excursion in a « covered carriage » — The two halves are numbered « 1 » and « 2 ».

ents such as *a. m.* and *p. m.*, or *outward* and *return* direction of travel.

MISCELLANEOUS SIGNS such as a spear head, a small star, a black coloured triangle in an upper corner and so on, are used to enable printers to centre Edmondson (and other) tickets so as to cut them accurately to size.

Other signs have some special meaning concerning the category of Edmondson tickets (figs. 649, 650) or revised fares; the French *Est Ry.*, for instance, used a hammer for the purpose (fig. 651).

The special signs which help to distinguish certain classes of tickets or to identify special trains have been dealt with in Chapter XII, D-3; we consider them again from another standpoint in Chapter XVIII which deals with ticket illustrations. But certain of them, such as the St. Andrew's cross (figs. 615, 687), diagonal and other lines which appear on some tickets, and particularly on Bri-

tish road transport ones, find their place here.

Blank stage spaces are often filled with crossed diagonals. Special markings separate some part of lists of places or fare stages to which a particular method of transport or special tariffs apply; and printed diagonals may have any of a number of meanings (figs. 444, 532). Thus one, two or three of them designate the class travelled in.

DIAGONAL HATCHING is also used for a number of purposes. Platform ticket night hours often have them (fig. 479), as also the return stages of road transport tickets when these have two lists for the two directions of travel.

When it is advisable to distinguish certain tickets at a glance such as all-day or workmen's weekly tickets, they are sometimes entirely covered with black or red hatching (fig. 323).

TICKETS ARE PRINTED parallel to the horizontal or the vertical side, circular setting of type having been definitively abandoned ⁽¹⁾ (*figs. 11, 104, 105*), as has the oblique arrangement used on early London and provincial tram and bus tickets (*fig. 473*), and Italian railways Edmondson tickets (*fig. 556*). Some American transfers still have oblique setting, particularly for scale-lists of time (*fig. 247*).

3. **Colour printing.** — There is really no typographical difference between black or colour printing, and several State Railways formerly printed their Edmondson tickets in colour such as blue in Bulgaria and green in Russia instead of the usual black. Elsewhere, special categories of Edmondson tickets are still printed in red.

Many road transport soft card or paper tickets are also printed in colours such as ultramarine, blue, green, olive, violet, orange, yellow, and especially red. These colour-printed tickets may be used one way, in opposition to black-printed ones used the other. Tickets delivered to certain categories of travellers, such as workmen and military, may also be printed in colour, as may be countermarks or exchange tickets.

PRINTING IN TWO OR SEVERAL COLOURS is not more complicated than printing in a single colour, although it might seem so at first sight, for in any case all tickets are partly printed beforehand and a second printing is always needed to add such particulars as differ from one ticket to another.

It was customary thus to print in

⁽¹⁾ It was recently used on some of the *Crosby* services.

green, on *P. L. M.* blanks of appropriate class colours a number of items common to them all :

A grid wherein the station name would later be written in or printed;

The word « going » or « return »;

The category (class of ticket);

Possibly, the designation of the tariff.

A later printing, in black, then differentiates them according to the Railway's needs.

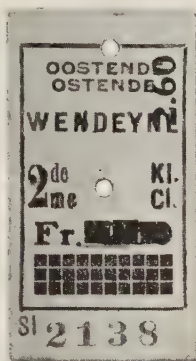
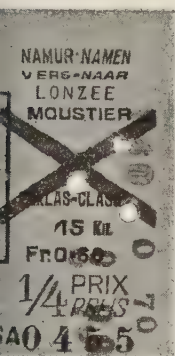
A similar second printing takes place in *A. E. G.* machines on appropriate blanks having certain red lettering pre-printed on them, which we have shown in figures 697 and 699.

The *Great Western Ry.* does the reverse; it pre-prints, all the text of its platform tickets with the exception of the station name in black, and adds in red the name of the place the tickets are to be sent to.

On the other hand, we have seen that various perforations are used to facilitate the severance of paper or Edmondson tickets. A coloured grid is sometimes printed on the former so as to show exactly where the perforations occur, whilst the *Southern Ry.* impresses Edmondson tickets with red line-perforation, which is plainest of all.

ROAD TRANSPORT TICKETS MULTI-COLOURED PRINTING. — Bi-colour tickets are common and are printed either in two colours or in a single one overprinted with a second. Even three-colour tickets are not scarce, the extra printings being in the second and third colours; thus the Company's crest may be added in a second colour, and further markings in a third.

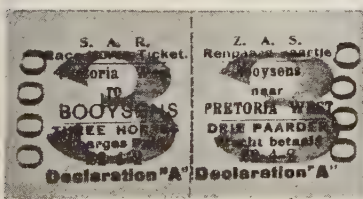
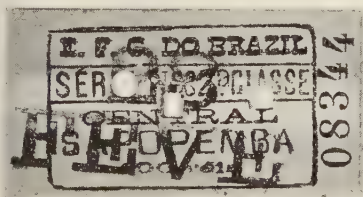
As a matter of fact, tickets printed in one or two colours are serially numbered



Edmondson tickets with overprinted revised fares. (Red. 4/5).

g. 615. — Three new fare values successively overprinted by hand — *Belgian National Rys. Co.* — Dated vertically — Category : Quarter fare denoted by St. Andrew's cross.

g. 616. — Two new fares machine-overprinted — The former fares are blocked out — *Belgian National Light Rys. Co* — Bilin-gual ticket.



Edmondson tickets with one of the original particulars altered by overprinting. (Red. 4/5).

617. — Overprinted date — *Central of Brazil Ry.*

618. — Number overprinted at second printing — *South African Rys.* — String (three) horses.

afterwards and whether this numbering be done in one or other of the original colours or printed in a third is indifferent.

Colours are primarily called upon to bring out certain items, and it should not be lost sight of that the abuse of multitudinous colours is dazzling and does not achieve the desired result.

Route maps, beautifully printed on paper tickets of German and foreign cities by the Berlin *Fasbender Printing Works*, deserve special notice (fig. 631).

4. **Overprints.** — Besides the background and letterpress, further particulars are added by overprinting the tickets (or have been added in « underprinting » which is the same for our purpose). These surcharges either complete the text, bring out certain items, or substitute others for them.

Adding a particular by overprint is really a third means of solving a problem we have twice dealt with. The first time, when perforating or otherwise marking one item of a limited-parameter list; the second time when writing the required item on an unlimited-parameter (blank) ticket.

In this third case, the ticket has no limited or unlimited parameters, and the particular that applies to it is just added to it whatever printing it has previously been provided with.

Any ticket may thus serve as support whether previously provided or unprovided with lists of particulars similar to the item that is overprinted on it, and which takes precedence over any other. A number of different particulars such as the following are thus overprinted on Edmondson tickets :

The price (fig. 287);

The class;

The number of days of availability (*fig. 228*);

The number of the destination station (*fig. 166*);

The number of the zone (*fig. 201*);

The number of passengers in a group (*fig. 193*);

The number of animals covered by the ticket (*fig. 618*);

The number of the week (*fig. 335*)

Letters showing :

The return portion (*figs. 231, 590*);

The outward portion (*fig. 703b*);

The initial of the class (category) (*figs. 458, 592*);

The initial of a station (*fig. 164*);

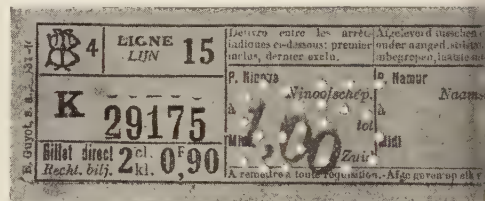
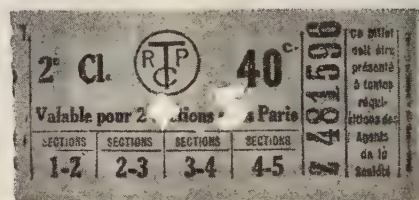
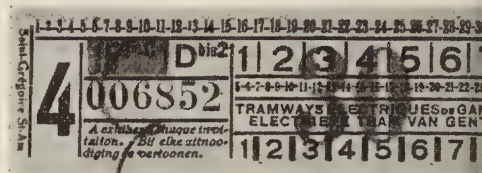
The initials of the Company;

The initials of steamship Companies' special trains.

Designs of various kinds are also overprinted on Edmondsons (*figs. 388, 478, 546*) and, on soft card tickets, text such as « Transfer » or « Train number so and so », all of which change or complete the conditions under which the tickets were originally issued.

Figure 169 shows a ticket blank card on which these extra printings have been pre-printed; they are post-printed on most of the others.

Particulars already printed on a ticket are sometimes further brought out by overprinting, which neither alters nor completes the original text, but simply emphasises it. This has been frequently done in connection with the *Bell Punch* stage fare ticket system where the price of the journey varies with its length. The ticket's letterpress is set up and printed at the same time as the fare. As it is desired the passenger be able to check whether he has been handed the proper ticket he has paid for, all penny tickets are white, all two-penny ones, blue, and so on, each of them being over-



Paper tickets with altered fares.
(Red. 3/4).

Fig. 619. — New machine-printed fare on original one blacked over — *Ghent Elect Tramways*.

Fig. 620. — Fare increase shown by punch holes — *Transports en commun de la Région parisienne (Paris District Public Transport)*. Fare stages listed in pairs.

Fig. 621. — New fare shown by perforated and third price substituted by hand overprinting — *Brussels Tramways Co.*. Available for one outward and a different return journey — With printing miller

printed with a large numeral representing the fare (*fig. 472*). It is indifferent whether this extra printing be done before or after the actual printing of the ticket.

REVISION OVERPRINTS substitute new for old data and so revalidate otherwise obsolete tickets. New regulations may necessitate a rearrangement of the text or

require some addition to it (*fig. 506*). The same applies when one Transport Company is taken over by another (*fig. 29*). And new tariffs may change all the fares, which may later, be altered once again (*figs. 615, 621*).

If one kind of ticket is temporarily unavailable, another may be overprinted as a substitute, even if altering one of its data causes others to change as well. The most usual alteration relates to the fare; this being the outcome of any and all other changes, a revised fare has no effect on the ticket's other particulars, but it is quite another matter when any of these is affected. Thus any change of category, of class or of one of the ticket's geographical particulars (with the occasional exception of the route) will cause a change of fare as well.

The same considerations apply to road transport tickets. Whether soft card or paper, they often bear several successive revised fares. Thus the *Brussels Tramways Co.* changed the line and all stage fares sometimes twice over besides altering the serial letter and three times the fare, and all on the same ticket!

All these surcharges are done by hand (*fig. 637*) or are machine-printed (*fig. 9*); they are occasionally written in as the amusing example shown in *fig. 614* whose Company's Welsh railway did not go anywhere near the places stated in its title. So it is hardly surprising that the final availability of the ticket had nothing to do with the places originally printed upon it.

Figures or signs may be ink-stamped on the tickets or punched through entire blocks of paper tickets, thus saving both time and labour (*figs. 620, 621*).

The overprint is supposed to cover the one it supersedes but it is frequently

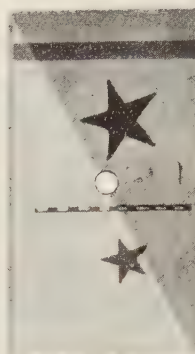
printed elsewhere so as to be more legible; the obsolete element is then cancelled by a line, a band or even a block-out, which French speaking printers somewhat appropriately dub « caviar » (*figs. 616, 619*). A Javanese motor bus Company went so far as to block out an entire triangular double entry table of fares and overprinting a new one next to it.

Finally, in case of ticket shortage or if an order has not been delivered in time, or even simply for reasons of economy, the whole face of Edmondson tickets may be cancelled and a new text be printed on the back of the original (*figs. 611 to 613*). This happened frequently during the War and its aftermath. It also occurred after Revolutions when so-called objectionable features of the Railway Company's name were made to disappear (*fig. 612*).

5. Printing on the back of Edmondson tickets. — Information of lesser importance is often placed on the back, as also extracts of the Company's bye-laws which must be printed on the tickets so as to strengthen the Company's legal position, but which need not necessarily be read. All that is required is that the holder has the chance of reading them should he feel so inclined; but he is not obliged to do so.

Tickets are frequently dated at the back and, in America, stamped with the date and the station's name by means of stamps similar to those used for cancelling postage stamps (*figs. 470, 474*).

In Belgium, Hungary and Austria and on some of London's underground lines, the lists of scheme ticket destinations are frequently printed on the back of the tickets. In other cases the route, the list of zones (Austria) and validation data (America) also appear there. In short, the back of the tickets is used as a com-



Coloured backs of Edmondson tickets. (Red. 4/5).

Fig. 622. — *New South Wales Govt. Rys.* — Dated on back — Band in « reserve ».

Fig. 623. — *Paris-Orléans Ry.* — Bicoloured ticket with special markings.

Fig. 624. — *Central Argentine Ry.* — Narrow vertical stripe and broad diagonal band of different colours.

plement to the front without there being any well defined rule as to the use of either.



Fig. 625. — Ticket with vignette showing category — *Swedish State Rys.*

As a rule the back is of the same colour as the front, save on multi-coloured tickets, and the distinctive markings are not necessarily identical on both sides (figs. 622 to 624).

The back of railway coupon-paper

tickets is often provided with spaces referring to possible stop-over places.

The back of light-railway paper tickets sometimes has a list of train numbers; urban transport tickets have lists of dates and hours for immediate use as transfers, or lists of places or of lines referred to on the maps of the system printed on the other side.

Finally, advertising matter is sometimes printed on the back of Edmondson tickets, more often on road transport card or paper tickets.

CHAPTER XVIII.

ILLUSTRATIONS.

Illustrative matter may form an actual part of the ticket so as to complete the letterpress, or it may merely enhance the ticket's artistic appearance. It is often printed in a second colour, in particular when used as a safety background.

1. Crests and monograms. — Companies often add their title or monogram to the text of their tickets so as to strengthen their legal position. Their names were printed on the first paper tickets and on many early British Edmondsons (*figs. 58, 451, 452*). They were also printed on the emergency paper tickets used in Belgium immediately after the Armistice (*fig. 277*).



Edmondson dog tickets with vignette. (Red. 4/5).

Fig. 626. — Return ticket with typographed vignette — *Paris Ceinture Ry.* — Vermilion border all round.

Crests and monograms appear on tramway and motorbus tickets (*figs. 416, 620*). As for the railway winged wheel emblem, it is to be found on any number of rail and road transport tickets (*figs. 405, 603*).

2. Forgery prevention. — Illustrative matter is often the main constituent of safety backgrounds. Instead of regular

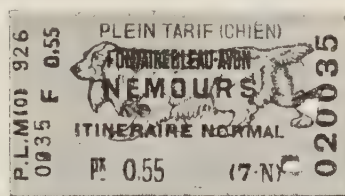


Fig. 627. — Green or blue coloured drawing in background — *P. L. M. Ry.* — Printed in two colours.

Ornate monograms appeared on the back of British and overseas Edmondson tickets in the fifties (*figs. 448, 449, 453*). Less elaborate ones had been used in Belgium since the late forties (*figs. 58 and 59*) and were still to be found on the continent up to half a century ago (*figs. 51, 451, 452*). Britain's coat of arms has been frequently called upon and the lion and the Unicorn are to be found on many kinds of tickets, ranging from Sydney's beautifully engraved coupons (*fig. 63*) to free passes delivered in Natal (*fig. 46*). The Companies' crests often stand out in gold on the covers of passes and seasons (*figs. 45, 313*).

geometrical drawings, complicated guilloche designs are often got out by special machines and printed both on card and paper tickets ⁽¹⁾. They have also been used for parts of engraved or lithographed tickets which deserve the highest praise (*fig. 366*, Japan; *figs. 342, 361, 396*, United States).

In many cases, the letterpress is printed on cards or sheets already bearing illustrations as a safety background (*fig. 440*). The subject is often a picture of some monument ⁽²⁾; it may also be a symbolic design relating to the category of ticket. Thus a herd of cattle serves as background to French railways drovers tickets, and dogs to *P. L. M.* Edmondson

(1) We have reproduced specimens of guilloche illustrations of Edmondson tickets (*figs. 34 to 436*), of coupons (*fig. 437*), of travel-elements (*figs. 369, 391, 392*) and of urban transport paper tickets (*figs. 231 and 382*).

(2) German paper tickets of the kind are shown, *figure 440*, and Japanese, *figs. 365 and 366*. Others exist in Poland (Warsaw) and in Italy (Milan, Padua, Bologna, Ferrare).

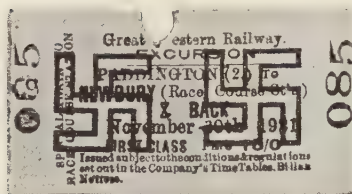


Fig. 628. — Swastika on *Great Western Ry.* ticket to special racecourse station — Category : Excursion.

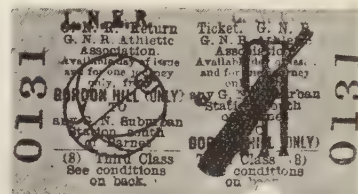


Fig. 629. — Football and cricket implements — *Great Northern Ry.* — Overprinted with initials of Company's successor, the *L. N. E. R.* — Issued to a sports club.

tickets, and other appropriate designs to various special ones (fig. 628, 629).

3. *Vignettes* differ from other illustrations in that they are typographed with the letterpress. A number of them show pictorially which kind of transport is to be used :

A winged wheel or a locomotive designate railways (fig. 91);

An anchor or a boat, river or sea passages (figs. 90, 176);

A horse or a carriage apply to tramways (fig. 97);

A motorbus indicates road transport.

The « International Convention's » regulations even obliged the Companies to use several vignettes on each coupon-ticket available, as the passenger prefers,

by rail, river or any other means of transport.

Such vignettes emphasise the category of Edmondson tickets : a bicycle (fig. 625), a dog (fig. 626), a territorial with a rifle (fig. 261), crossed flags for military (fig. 467), enable explanatory matter to be dispensed with.

In other cases, vignettes only have a typographical significance and concern the « form » number, as in Hong-Kong (fig. 543). They may also have a conventional meaning as the French *Est* shamrock on tickets whose fare has been revised (fig. 651). A series of symbols indicates the various weeks for which certain American paper passes are available (fig. 308).

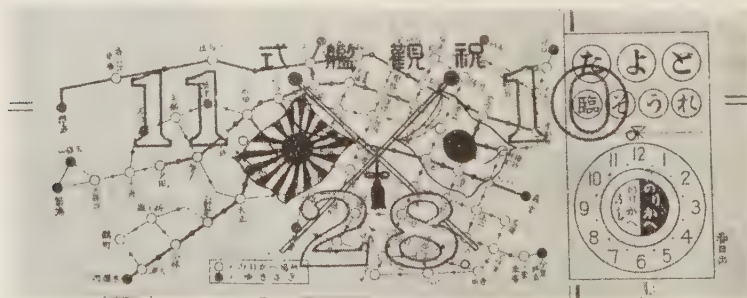
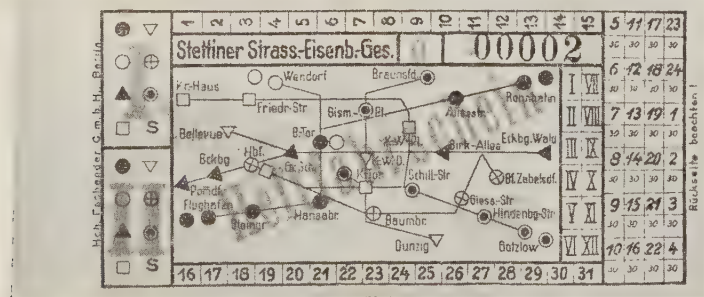
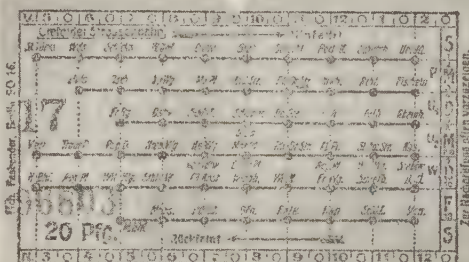
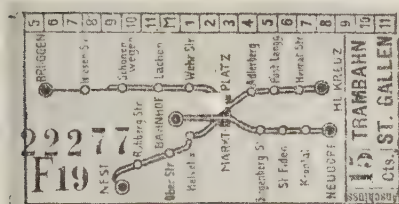
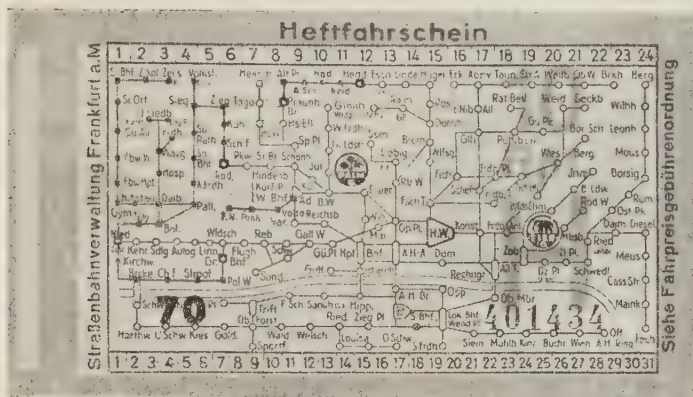


Fig. 630. — Japanese commemorative paper ticket with date and crossed Japanese and Korean flags overprinted. (Red. 3/4) — Map of system, hour dial, etc.



Paper tickets with maps or graphs. (Red. 3/4).

- g. 631. — Bicoloured map of system, *Frankfurt Tramways* — Vignettes denoting botanical and zoological gardens — Coloured border all round.
- g. 632. — Map of *St. Gall Tramways*, showing single and double-track sections.
- g. 633. — *Crefeld Tramways* — Graphic representation of fare stages on each route.
- g. 634. — Map of *Stettin Tramways* system, with different indication of fare stages on each route and 1st and 2nd-class references for punching.



Fig. 635. — Old illustrated Turkish ticket.
(Red. 3/4) — *Shaira tramways*.

the availability of tickets or passes is to do so geographically.

Maps of fixed circular tours are often printed on railway paper coupon tickets; this device, which originated in Italy has spread to many other countries.

Maps are rarely printed on Edmondson tickets although they are occasionally to be found on the back (fig. 482). Season tickets also have them, particularly when they entail free travel over the whole or part of a system, such as on



Old illustrated Spanish paper tickets — Issued towards 1875. (Red. 4/5).

Figs. 636a and b, and 637a and b. — Caricatures issued by the *Barcelona, Ensanche y Gracia* and the *Madrid Eastern Tramways*.

Figs. 638a and b. — Scenes from bull-fights, *Madrid Eastern Tramways* — The second ticket has a new fare over stamped by hand.

4. Graphic representation of certain particulars. — MAPS OF THE SYSTEMS. — The least cumbersome way of showing

the L. C. C., now *London Transport* (fig. 483).

Free passes often have maps printed

n one, two or even three colours (*fig. 333*). But the most extensive area of availability is that shown on the folding map contained in the free passes issued to members of the sessions held by the « International Railway Congress Association » for it covers not only all the railways of the country where the Congress is sitting, but also all the railways of Europe which lead there.

The object of the PLANS, widely used for road transport, is very different, as these tickets are only to be used for one particular journey chosen among all those the ticket is good for. Any other system of ticketing would be infinitely more cumbersome and necessitate a quantity of different tickets for every line. A single geographical one applies to the entire system and all that need be done is to mark, for checking purposes, the limits of the proposed trip and, possibly, the transfer points. The plans must be suitable and this is the reason why we consider them here.

Figures 212 and 213 show the earliest of these plans or maps as used in Antwerp and in Lyons towards the end of 19th century. Since then, it has been found possible to squeeze the whole of the most complicated systems on the small area available on a paper ticket (*fig. 631*).

The older Companies ran few lines and the earlier maps went so far as to indicate double trackage and the direction followed by the cars (*fig. 632*). As systems are no longer so rudimentary, it has become necessary to draw them schematically (*figs. 215, 216*), but such stylization should not be carried too far as is apt to make map reading incomprehensible.

The production of these maps is quite



TRAMWAYS NATIONAUX

Old chromolithographed paper tickets, 1878. (Red. 4/5).

Fig. 639. — *National Tramways*, Antwerp, with advertisements.

Fig. 640. — *Brussels Tramways Co.* — Set of flowers and costumes.



Old chromolithographed tickets, about 1878. (Red. 4/5).

Fig. 641. — *City of Buenos Aires Tramways*, with publicity matter and a view of London.

Fig. 642. — Advertisement on old Munich Tramways ticket.



an art. Different kinds of lines are used : thick and thin, broken or dotted. The *Fasbender Works* print their maps in two colours, generally black and red, sometimes in blue or green as well, which enable the same tickets to be used on sections having different fares (*fig. 214*).

When need be, and especially when the system radiates around a centre counting as No. 0, concentric circumferences showing fare zones are added (*fig. 202*). Non radial routes, when extant, can be shown separately at the sides.

Each line's number or letter may be printed along the sections of the route (*fig. 480d*), or the names of the termini only can be given (*fig. 483*). The fare stage points may be shown by various signs such as small circles, triangles, squares and so on (*fig. 631*). These signs may alternate along the lines or signs of different shape may apply to different routes (*fig. 634*) ⁽¹⁾.

TRIP GRAPHS are exceptional and are used in different ways. In the first, a number of horizontal lines are ruled, each showing all equidistant stage points. Vertical columns are drawn through them and numbered from 0 onwards, the numbering applying once for all to all the stages of every line (*fig. 633*).

Elsewhere, as at Teplitz, the reverse process is applied. A list of fare stage points is shown vertically and all possible journeys at the same fare are shown vertically and limited between horizontal lines running through the stage points (*fig. 637*).

5. **Artistic tickets.** — Free passes and multi-trip cards were often drawn instead of printed with current type, thus producing beautiful examples of the graphic arts (*figs. 24, 331, 342*). This also occurred on tramway systems (*figs. 108, 213*). Paper tickets with a map of the line were at first chromolithographed, the picture so produced is amusing (*fig. 384*).

We have previously examined illustrations used as backgrounds. But we would draw particular attention to the collections of illustrated tickets which thrived during the seventies and the early eighties.

Spain had sets of black or coloured humorous pictorial tickets (*figs. 504, 636*). As the public took to them, more elaborate ones were got out in chromolithography; they represented scenes out of « Don Quixote », operas such as « La Mascotte », or characters out of the Italian Commedia del' Arte (*figs. 502, 576*).

Chromo sets of portraits appeared in Barcelona (*fig. 500*); typography was used for others in Rio (*fig. 645*), and heliogravure in Rome (*fig. 501*). These tickets formed sets which were eagerly sought after and were scarce at the time; they are now unobtainable.

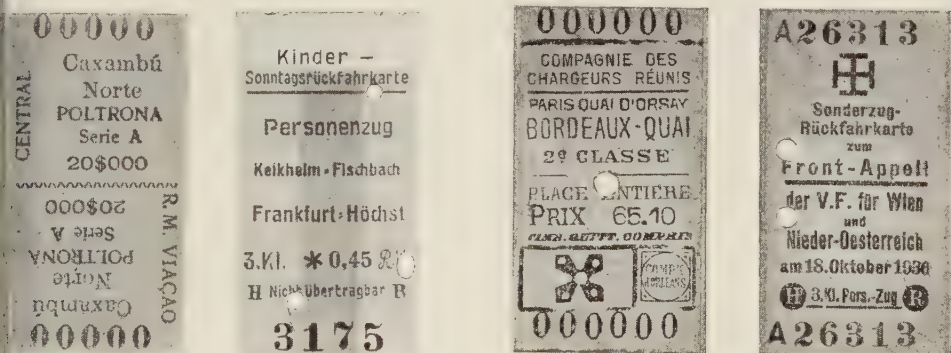
In 1878, during the Safety and Hygiene Exhibition which was held in the Parc of Brussels, two of the Tramway Companies issued chromolithographed tickets, one set showing flowers (*fig. 640*), others local customs. And all the time, further sets of tickets were appearing elsewhere.

There were sets of animals in Rio (*fig.*

(1) In Stettin, through a carefully thought-out arrangement of these signs the number of particulars the conductor must indicate has been reduced. They are repeated in proper sequence once for 1st and again for 2nd class. Route and class can thus be shown by a single perforation.



Backs of paper tickets of the *Rio Botanical Garden Co.* (1907). (Red. 4/5).
Figs. 643, 644. — Set of music hall and circus numbers and caricatures.
Figs. 645, 646. — Set of portraits of sovereigns and others (see back, fig. 600).



Various Edmondson tickets. (Red. 4/5).

Fig. 647. — Interline supplement — *Central of Brazil Ry. and Minas Ry. System* — Coloured arc perforation for breaking it into halves.

Fig. 648. — Child's Sunday ticket, *German State Railways*, with distinguishing marks — A vertical azure band for Sunday, and white border at top (child) — For slow train only.

Fig. 649. — Railway ticket issued through a shipping Company Agency — Duty stamp included in the fare — Special marking — Name of Railway Company in right-hand corner.

Fig. 650. — Return ticket with Austrian cross — Issued to members of one of the political parties.

The tickets of the *Rome Omnibus-Tramways Co.* were the first to be illustrated with views which were produced

in heliogravure, industrial photography being in its infancy. Next came Bahia's beautifully engraved monument tickets, and more recently German « phototypie »

views (*fig. 536*), and Japanese offset ones (*fig. 568*).

After having gone out, pictorial tickets seem to be coming to the fore again. The covers of the Paris transport-element have portraits on them and many an American urban or interurban weekly pass has a picture having some connection with the week concerned (*figs. 309, 310, 344*). Such passes are eagerly collected by American ticket fans, which helps to make them popular.

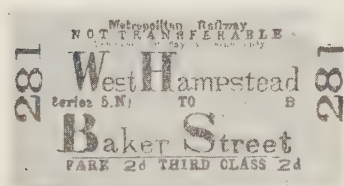


Fig. 651. — French *Est* Railway ticket, with shamrock symbolising an increase in fares (Red. 4/5) — Company's name in lower left hand corner.

Fig. 652. — *Metropolitan Railway*, London. Ticket with distinctive initials for station names. (Red. 4/5).

6. Illustrated advertising matter completes the ordinary letterpress and, as could be surmised, has often taken the place of purely artistic productions. Figure 555 shows fashion plates instead of Rome's previous portraits and monuments (and the plates are no less interesting than the views), whereas, the Brussels « flower tickets » ran to seed, advertisements took their place and polychrome publicity appeared soon afterwards on Antwerp, Turin, Munich and Buenos-Ayres tickets (*figs. 639 to 644*).

PART I.

PRINTING AND ISSUING MACHINES.

The advantages of self-printed tickets are considerable, and four of them are paramount :

They do away with the entire stocks of pre-printed tickets. These acquire a monetary value as soon as they are printed, hence a considerable capital is tied up in the stocks and there is a certain risk in dealing with them. Accountancy is quicker, cheaper and easier. Ticket issuing is speeded up. Fraud is eliminated, which constitutes a guarantee for the Company and a protection for the staff, thus placed beyond reach of suspicion.

Besides these advantages, others, which accrue from them, are not negligible :

There is a considerable saving in the cost of the tickets;
The labour involved in dealing with the stocks of pre-printed tickets is abolished and the number of ticket stock departments becomes negligible;
Waste ticket stocks, due to change or extension of route or changed stages or fares, are prevented;
Station and train staff records are simplified;
Saving of man-hours when issuing and receiving at the commencement and termination of turn of duty is noticeable, only a few minutes being involved in changing over. The machines can be used most of the 24 hours.

Unfortunately, considerations other than sole advantages intrude. The high cost of Edmondson ticket machines must be taken into account and in each case, it must be ascertained whether the advantages outweigh the disadvantages, the decision depending on the amount of traffic ⁽¹⁾.

A comparison between the cost of pre-printed tickets and others printed as issued has been worked out at the Brussels-Nord station and it was found that the price varied around a mean figure, being lower in the summer months at the height of the traffic and higher in winter. But certain of the machines' advantages, such as simplification and greater accuracy of the accountancy, cannot be expressed in figures.

In spite of this, since only large sales of tickets justify the purchase of these costly machines, it was impossible to equip others than the most important stations with them unless some use could be found for them during the slack hours. It was suggested the smaller stations might send in invoices for the tickets they needed which the machines should print instead of standing idle. This interesting point is now under consideration.

(1) When machines were introduced at the Friedrichstrasse Station, Berlin, the gain in space enabled shops to be put up and let; the rents received in the first year covered the purchase price of the machines.

Mechanical printing and issuance of road transport tickets is of equal interest and must comply with different requirements. We have therefore grouped all ticket machines under different headings as under :

Edmondson ticket printing and issuing machines.

CHAPTER XIX.

MACHINES WITH ONE PRINTING CELL PROVIDING TICKETS FOR A NUMBER OF DESTINATIONS (MULTI-PRINTERS).

- A. The « Contrôleur machine », 1897 model.
- B. The « Contrôleur machine », 1902 model.
- C. The « Contrôleur » typewriting machine.
- D. The *Pautze* machine.
- E. The « Regina » machine.
- F. The *A. E. G.* machine.
- G. The « reduced » *A. E. G.* machine.

CHAPTER XX.

NON AUTOMATIC MACHINES HAVING AS MANY PRINTING CELLS AS DESTINATIONS (RAPID PRINTERS).

- H. The « Printix » machine.
- I. The « S. P. » machine.
- J. The 1900 « *Paris Metropolitan Ry.* » machine.
- K. The 1907 « *Paris Metropolitan Ry.* » machine.
- L. The *A. E. G.* rapid-printer.

CHAPTER XXI.

AUTOMATIC MACHINES.

- M. Miscellaneous machines.
- N. The *A. E. G.* automatic machine.
- O. The « S. P. A. » machine.
- P. The *Brecknell, Munro and Rogers* automatic machine.

Machines for printing and issuing paper tickets.

CHAPTER XXII.

- Q. The « T. I. M. » machine.
- R. The *Clayton-Harris* « Verometer ».

S. The *Siemens* « Autowaybill ».

T. The portable *A. E. G.* - *British Westinghouse* machine.

U. The *Ohmer* register.

* * *

EDMONDSON TICKET PRINTING AND ISSUING MACHINES.

Two different principles have been embodied in these machines.

A number of them with which we deal in Chapter XIX, have a single printing mechanism and a number of plates or blocks from which the one applying to the intended journey is selected. These machines differ from each other in the way the required plate is selected, brought to the printing mechanism and returned to its place after use.

In the second group of machines, described in Chapter XX, there is a separate printing element for every plate, each being independent of each other.

Machines of the first group print tickets of a number of categories for over 2 000 destinations; those of the second group, for a few only.

CHAPTER XIX.

Machines with one printing mechanism providing tickets for a number of destinations (Multi-printers).

There are three types of these machines, one with a double composing unit, a second with one unit and a printing mechanism, and a third using ordinary stereo-plates.

A and B. The « Controller ticket checking and issuing machine » as made by the « *Appareil Contrôleur* » Company.

Paris, which has been used by various Companies such as the French *Nord* and *P. L. M.*, the *Belgian State Rys.*, the *Paris Metropolitan Ry.*, the *Dutch Holland Ry. Co.*, prints, checks and issues tickets. It has been improved from time to time and been described in several technical journals ⁽¹⁾. We have used some of this information to complete the data the Companies have kindly sent us and give, for the first time, a complete account of the machines and of their use.

A. The « **Checking Machine** », 1897 model (*Appareil Contrôleur*) (figs. 653 and 654) was tested at Paris Nord (Ceinture) station. It prints tickets on strips of plain carton coloured according to the class to be travelled in, and issues them through three separate slots, one for each class. A characteristic of the tickets resides in their being made up of separate printings on their upper and lower half. The upper (and smaller) portion shows particulars which apply only to the issuing station (figs. 658, 659) :

The name of the station;

The moment of issue (date and time);

The class of carriage;

The category (full, half- or quarter-fare);

Also, the upper portion of the ticket's frame.

The following variable particulars appear on the lower half of the ticket

Name and number of destination station;

The fare;

The number of the ticket;

Also the lower portion of the frame of the ticket.

Two composing units are used for printing, which is done upwards. One of these units is fixed; the movable one is

brought up for printing, to the level of the former. The strips of carton are stored in the stand, whereas the mechanism is in the upper portion of the machine.

The large upper drum has four circular segments, as if four narrow drums had been placed behind each other. The front one only is fixed; it bears on its periphery the names of all the stations for which tickets can be issued. The three others are movable and may rotate; each of them carries, in the same order, a set of composing units which each print the lower half of the ticket and a control strip. A steering wheel similar to a motor car's bring any required composing unit opposite the corresponding inscription on the fixed segment; this wheel is clearly shown in figure 653, in front of the drum.

On pressing a release button, the printing table rises, at the same time forcing away all the parts relating to the printing of the control strip by means of a rod, while it presses the carton against the composing units which print the two parts of the ticket.

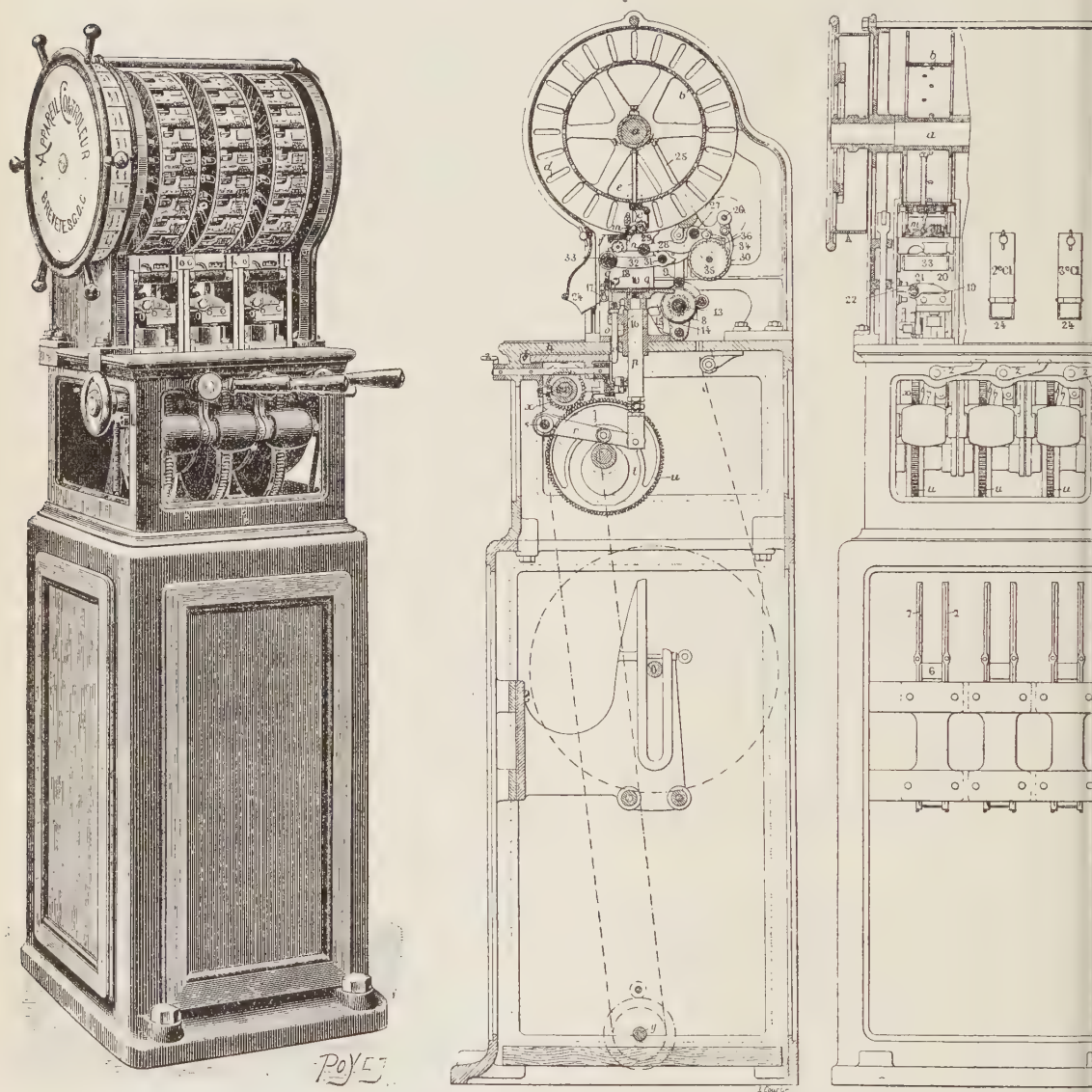
As the table rises, a cutter is lifted clear.

Printing having taken place, the table descends and causes the drum against which the strip was pressed, to make one third of a revolution which forces the strip to advance by the length of a ticket. This allows the cutter to drop and cut the strip off so that the ticket may fall through the hopper.

Whilst the movable composing unit descends, it strikes a catch which causes a ratchet to advance one step and to increase the serial number by one digit.

(1) See the articles of Mr. Leo and Mr. Dugit-Chesal, both of the *Nord Ry.*, in the *Revue Générale des Chemins de fer*, 1898 and 1904.

See also an article by Mr. J. Hervieu in the *Portefeuille économique des Machines*, Paris.



Figs. 653, 654 (*). — The 1897 type « Controller », printing, issuing and recording machine.

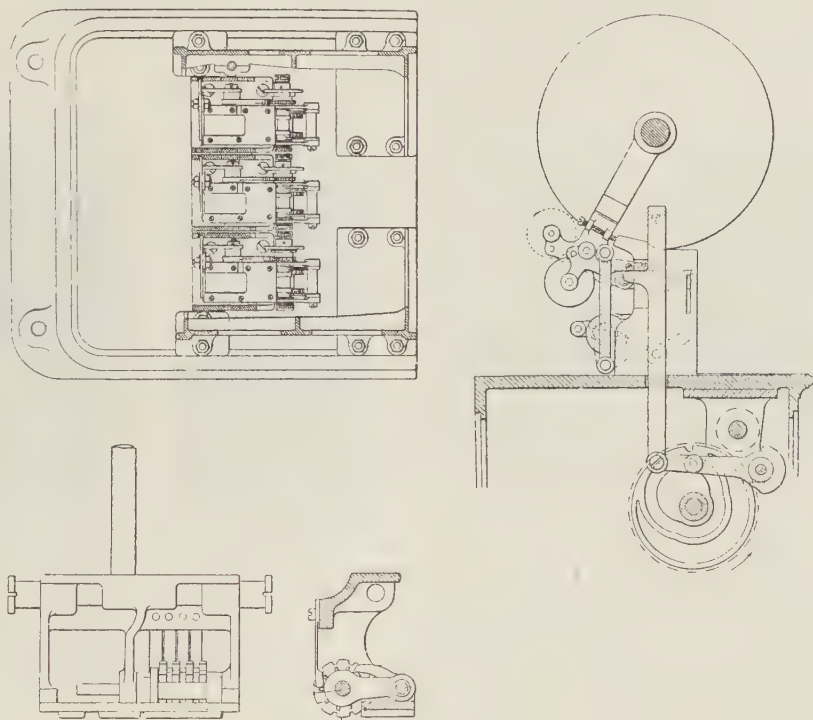
(*) These illustrations and figures 655 to 657, are reproduced from the *Revue Générale des Chemins de fer* for February, 1898. The letters and numbers in figure 654 refer to the very complete description published in that journal.

In addition, when descending, the printing table restores the control strip mechanism, which allows of its printing; rods are raised by a cam and the movable composing unit is returned to its original position. Owing to the movement of

which has been printed upon is immediately wound up proportionally.

Checking is thus very simple; it is limited to adding up the figures on the check band.

Should other categories of tickets,



Figs. 655, 656. — Details of the 1897 type « Controller » machine — Arrangement of the three drums corresponding to the three classes, with details of mechanism.

These rods, the control strip has been pressed against the corresponding parts of the movable composing unit which has printed the variable particulars (serial number, destination station and fare) on it.

An auxiliary movement causes an ink roller to pass over the fixed and movable composing units and the checking band

such as returns or special tickets be required, modified composing units provide them (figs. 660 to 663).

B. The 1902 model of « Checking » Machine (Appareil Contrôleur) in use at Enghien-les-Bains (*Nord Ry.*) since 1904, differs in many ways from the 1897 one (figs. 664, 665).

The large drum has been done away with. Instead, the composing units are fixed to one or more parallel Galle chains which are wound over a large drum and whose other end is free, being kept sufficiently taut by its own weight. In practice, each chain carries up to 100 composing units, which are brought up to 200 when two chains are used. As their length increases with the number of units they have room for, an extra space of 8" per 10 units must be pro-

other way and there is more room for storing the carton.

In this case, the apparatus for serial numbering the tickets is an integral part of each composing unit. The latter therefore actually comprises three separate printing mechanisms :

(a) At one end, the elements for printing the lower portion of the ticket;

(b) In the centre, a set of four numerical discs;

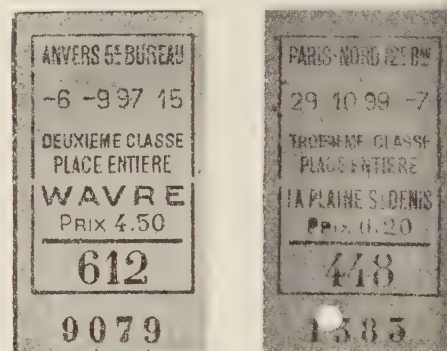
(c) And on the right, fare and destination printers which print simultaneously both on the ticket and the check band (fig. 666).

0001	LE LANDY	0 30
0002	LE LANDY	0 30
0001	S ^r - DENIS	0 55
0001	AV DESBAT	0 40
0002	S ^r - DENIS	0 55
0003	S ^r - DENIS	0 55
0001	LA PLAINE	0 30
0003	LE LANDY	0 30
0002	LA PLAINE	0 30
0003	LA PLAINE	0 30

Fig. 657. — Fragment of check band of 1897 type « Controller » machine — French Nord Ry. (Red. 3/4).

vided under the machine when there are more than 80 units per chain.

The carton magazine can no longer be placed in the stand. Therefore the reels of carton strips are fixed at the top of the machine in the position the 1897 model drum used to occupy, and the tickets are printed broadwise instead of lengthwise. This way of printing has a double advantage : the printed tickets only have to move 30 mm. ($1 \frac{3}{16}$ ") forward each time instead of 56 mm. ($2 \frac{3}{16}$ ") if they had been placed the



First soft card tickets printed as issued by the 1897 type of « Controller » machine. (Red. 4/5) — Date and time shown by proper grouped numerals.

Fig. 658. — Belgian State Railways.

Fig. 659. — French Nord Railway.

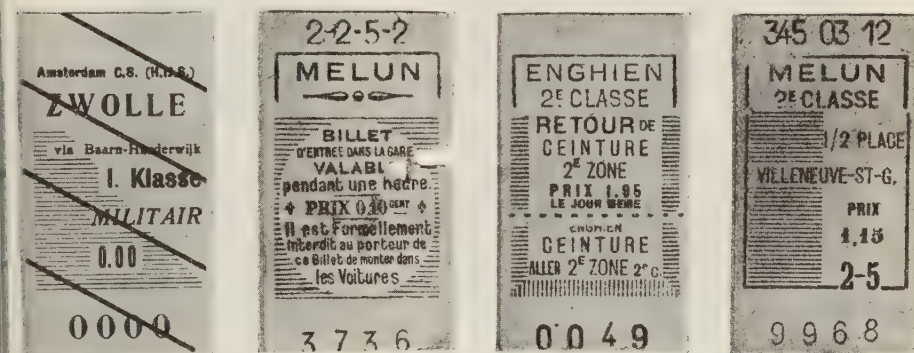
OPERATION. — The operator releases the large drum by lowering a lever which removes a locking roller from the notch of the drum's circumference in which the chain was engaged. He then turns the spoke of the wheel, as in the earlier machine, in order to bring any required composing unit into position; this forces the chain that carries it to revolve. At the top of the machine, a dial with an indicating needle actuated by a transmission off the drum, shows whether the operation has been properly done.

A locking lever is lowered to fix the unit firmly in place. The lever further lowers a platen which pushes the inking roller away and in so doing, forces it over the composing unit. Besides this, it engages the pawls which control the progress of the serial numbering on the ticket and check strip in their ratchets. This is only at the end of the lever's and

ticket is cut and ejected. All is then again in its proper place.

A simple device compels the operator, once the lever has been handled, to move it full stroke down or up.

The CHECK BAND. — The particulars are differently placed here (fig. 667). An ingenious four-column arrangement enables the amounts received for each ca-



Almondson soft card tickets printed on the 1902 type of « Controller » machine, showing arrangement of ruled lines to distinguish the various categories of tickets. (Red. 4/5).

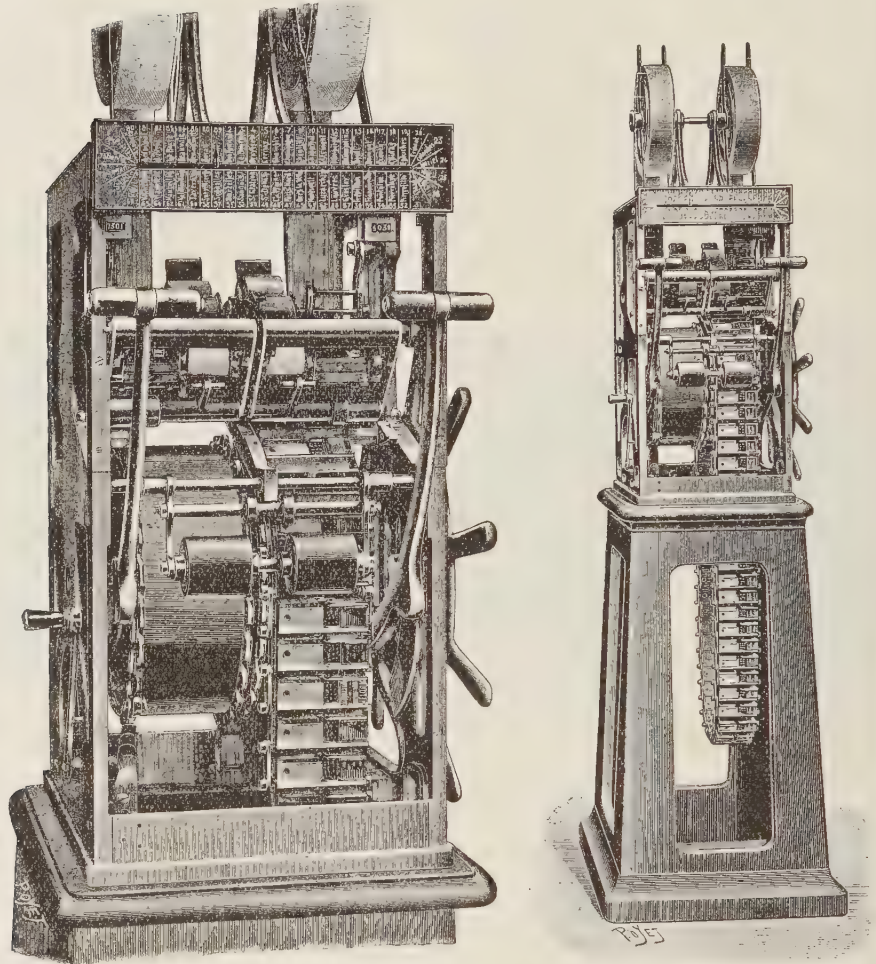
- Fig. 660. — Category : Military. *Holland Railway Co.* — Red diagonal bars draw attention to the fact that the designation and category are different from those of other tickets.
- Fig. 661. — Category : Platform ticket — *P. L. M. Ry.*
- Fig. 662. — Category : Zone return ticket with detachable stub. — *French Nord Railway.*
- Fig. 663. — Category : Half-fare ticket — *P. L. M. Ry.*

When the lever rises again, the strip moves out and that printing finally takes place.

When the lever rises again, the strip moves out and that printing finally takes place. Then the lever rises again, the strip moves out and that printing finally takes place. Then the lever rises again, the strip moves out and that printing finally takes place.

category of ticket (military, quarter-rate, half-rate, return or full fare) to appear in different columns where it is easy to add them up separately.

Should a quick analysis of results be required at any time, the position is taken directly from the machine onto a sheet of paper pressed by a rubber roller against the chain's composing units. This sheet is only pressed against the part of the units giving the checking particulars



Figs. 664 and 665 (*). — 1902 type « Controller » machine.

and the serial number of the following ticket of the category concerned.

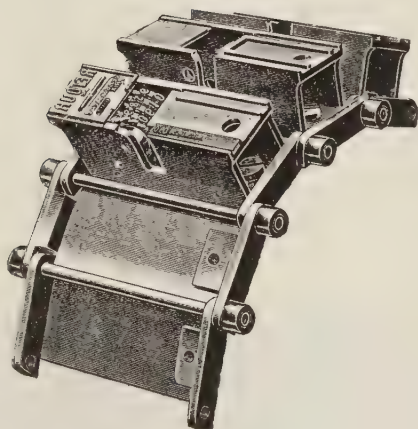
THE TICKETS (figs. 668 to 670).— These machines are used in groups of three, one for each class of travel. Each prints

full, half- and quarter-fare tickets, and the machine issuing 1st class tickets also issues the special dog tickets.

All tickets, even returns, are only dated once, the latter on the return po

(*) These figures and figures 666, 667 and 673 are taken from the excellent paper published by Messrs. Leo and Dugit-Chesal, of the French *Nord Ry.*, in the *Revue Générale des Chemins de fer* for June, 1904, from which certain particulars have been taken.

MILITAIRE: 1/2 PL A. R. PL. ENT^{re}

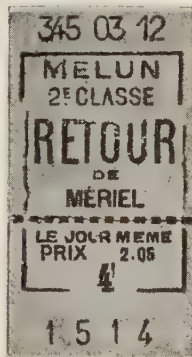
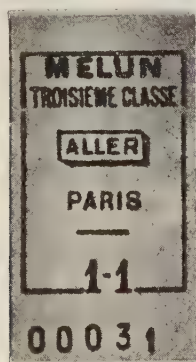


ARGENTEUIL	0.30
1.60	BEAUVAIS
PONTOISE	1.20
CHANTILLY	4.40
VALMONDOIS	3.80
1.30	VALMONDOIS
COMPIEGNE	5.15
0.10	SAINT-DENIS
EPINAY	0.60
EPINAY	0.60
ARGENTEUIL	0.30
MONTDRENCY	0.60

1902 model « Controller » machine.

Fig. 666. — Portion of Galle chain with two printing units, one fitted with a printing plate, the other without.

Fig. 667. — Fragment of check band, with text so arranged that the sums corresponding to each category of ticket are in the same vertical columns. (Red. 3/4).



Various sorts of soft card Edmondson return tickets issued by the 1902 model « Controller » machine, and used on the *P. L. M. Ry.* (Red. 4/5).

Figs. 668 and 669. — Separate tickets for outward and return journeys.

Fig. 670. — Return ticket, with detachable stub. •

1. When the dating of the outward journey is required as well, a special coming unit is added so as to dry-date the

outward half at the back, when the platen has completely risen.

The number of different machine-

printed tickets issued at a station such as Enghien, was 412 :

CATEGORY :	Machine for		
	1st. cl. tickets.	2nd. cl. tickets.	3rd. cl. tickets.
Full fare	28	42	102
1/2 fare	17	21	39
1/4 fare (military)	8	12	23
Return, adults . .	19	35	32
Return, child. . .	1	1	1
Dogs, full fare . .	13	—	—
Dogs, return . . .	2	—	—
Blanks	6	5	5
	94	116	202

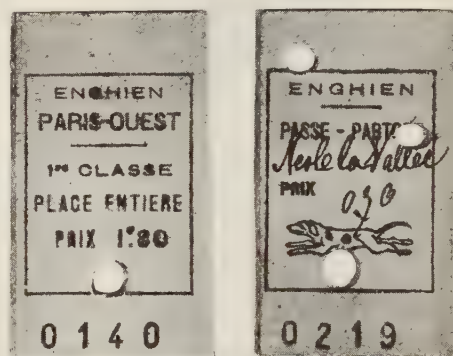
These machines having worked satisfactorily (figs. 671, 672), others were placed, in 1911, in one of the Paris-Nord booking offices, but no further machines have been ordered since. This was due to their being slow, cumbersome and fatiguing to work. When they were no longer able to cope with the ever increasing demand for tickets, they were removed to Enghien to take the place of the original ones which were then scrapped. The machines are still in service there, whereas the Paris-Nord booking office was provided with ordinary tube racks.

C. Typewriting blank ticket machines (fig. 673). — When the mechanisation of main-line booking offices was started, the question of blank tickets was immediately raised and this machine was added to those we have just described, so as to deal separately with blank tickets. It differs from ordinary typewriters in that each key operates two characters, one of which strikes the ticket, the other the check band. Machines have also been produced where the keys operate as many as three characters each.

In ordinary typewriters, the paper on which the typing is done moves horizontally whenever a key is struck. In these a carriage holding the ticket and check

band moves vertically instead of horizontally. This movement is similar to that of the « Contrôleur » checking machine and less than if it were placed the other way. This main carriage contains an auxiliary ticket carriage which moves at right angles to its own line of travel.

The destination having been typed, a special key causes the auxiliary carriage to move horizontally (therefore, perpendicularly to the writing on the ticket) so



Edmondson soft card tickets issued in 1911 by the « Controller » machine at Enghien. French Nord Ry. (Red. 4/5).

Fig. 671. — 1st-class full-fare ticket.

Fig. 672. — Dog's semi-blank ticket with vignette.

that the next inscription shall appear on it one line lower than the first. The fare is therefore typed immediately under the previous inscription and not, as in the « Contrôleur » checking machine, next to it. In the meantime, the same extra inscription has been typed on the check band of the main carriage but as the latter has not moved, it has been typed on the same line as the first inscription and a little to the right.

A second displacement of the auxiliary carriage takes place when the period of

availability is typed under the fare, but in, as the main carriage has risen regularly, the figures typed on the check and are not shifted and are also typed on the same line as the previous inscriptions.

When removing the ticket from the auxiliary carriage, a mechanism similar to that of the « Appareil Contrôleur » checking machine forces the check band

of the actual issue of tickets and simplifying of the accountancy work, the machines eliminated the large stocks of different kinds of pre-printed tickets, this being of particular importance under German conditions where different tickets are still used for « Schnellzüge » (expresses), « Eilzüge » (semi-fast trains) and « Personenzüge » (slow trains).

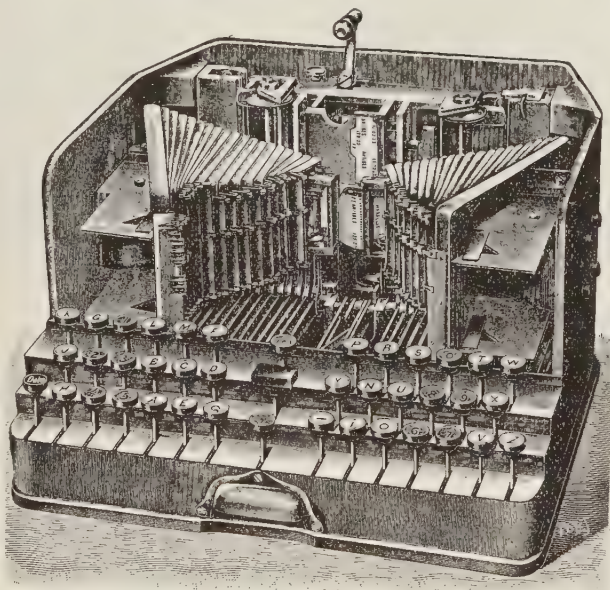


Fig. 673. — Typewriter, built by the « Contrôleur » Works, for issuing blank tickets.

advance and all is ready for typing the ticket.

The first Pautze machine dates from 1931. The principle of its design derived from that of the earlier Sieber machines which are no longer manufactured. Fifty of the most important German stations are now equipped with these machines (fig. 674).

In addition to a certain speeding-up

The Pautze machines differ essentially from the others in that the stereo-plates are curved and are taken, as required, out of a plate cabinet where they are arranged alphabetically, and carried to the machine. By pressing down a single key, representing the type of train and the carriage class, the machine prints and delivers a ticket at each turn of the rotary printer. Including the selection and transport of the stereo-type, the whole process takes but 6 seconds.

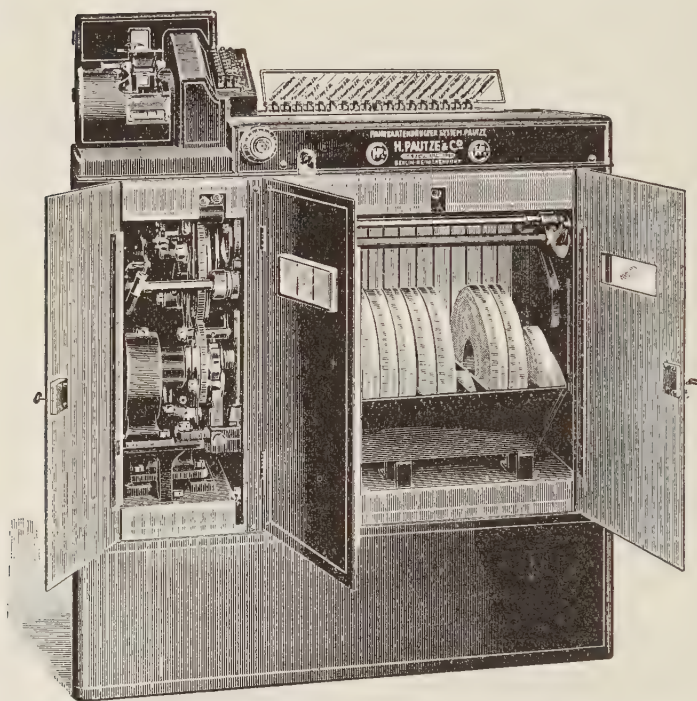


Fig. 674. — *Pautze multi-printer for printing, issuing and recording tickets.*
Right-hand side : carton roll magazine.

The actual printing is done partly by movable stereo-plates and partly by the machine itself (fig. 677).

Each curved stereo-plate (fig. 675) bears a plate for printing

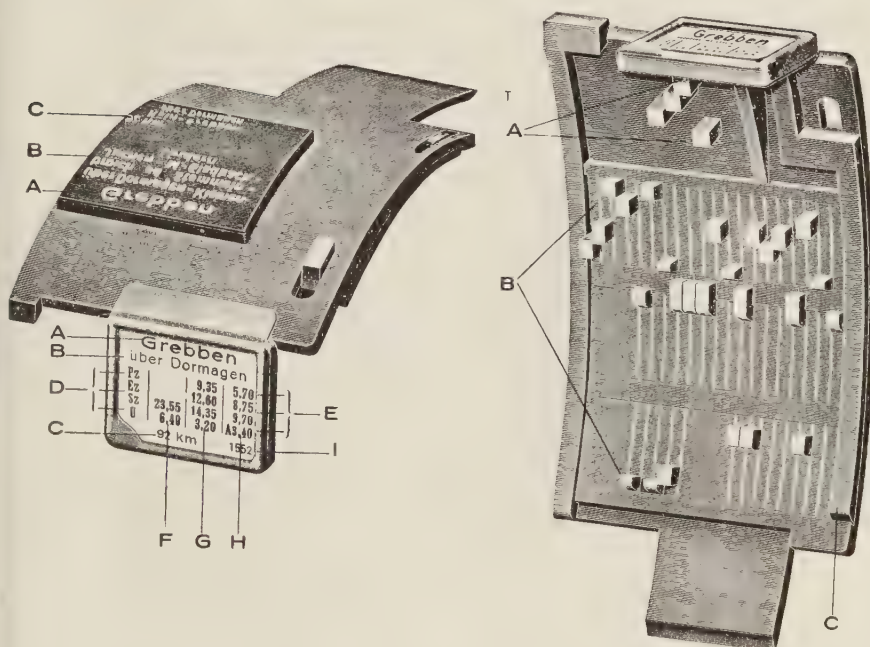
- The destination station;
- The route to be followed;
- The distance in kilometres;

The number of the stereo-plate which, as a matter of fact, is the same number as the punched card number for the destination station, and only appears on the check band, which is wider than the ticket.

Each plate carries a framed card or tab about one inch square to face the booking clerk. It shows him, for each

class of carriage and each kind of train, all the possible fares to the destination station, besides giving the route, the distance and, once again, the number of the stereo-plate. This information is necessary to show the clerk which plate he is using, and does away with the necessity of turning up any documents giving fares, etc.

On the under side of the curved plates are a series of stops equivalent to the basic information; they are slotted and work into corresponding holes in the machinery of the machine itself. This is accomplished by a number of keys, similar to those used in automatic registers and situated on the right-hand side



Figs. 675, 676. — Upper and lower faces of Pautze machine's stereo-plates.

Legend of label:

Destination.
Route
Distance, in kilometres.
Categories of tickets.
Fare per class and category.
H — Classes of carriage.
Number of the stereo-plate.

Legend of lower side:

A — Series of stops for adjustment of stereo-plate number in the strip for punching holes.
B — Fare stops.
C — Locking ridge.

machine. They cause the following particulars to be printed in black by stereo-plate :

1st, 2nd or 3rd class express (Schnellzug);
1st or 3rd class semi-fast train (Eilzug);
1st or 3rd class slow train (Personenzug);
1st class workmen's return;
1st class military;
1st class holiday return.

The categories vary from one machine to another and this list is simply quoted as an example of a frequent arrangement. The most usual machines have 8 to 10 enabling each stereo-type to print

as many categories of tickets. A cabinet containing 75 stereo-plates occupies an area of 6.4 sq. ft. and copes with 750 kinds of tickets. A machine with two 500 stereo-plate cabinets issues 10 000 different kinds.

In addition to the particulars listed above, the machine prints complementary data, in various colours (figs. 679, 680) :

In blue — The date (day, month and year);
In red — The type of train;
In black — The issuing station;
In black — The class of carriage and fare;
In red — The serial number of the ticket.

the numbering being continuous and not divided into series.

The date is, of course, constant throughout the day; the issuing station is always the same. On the other hand, the fare to any one destination varies for each type of train and for each class of carriage.

TICKETS are printed on differently coloured carton according to the category. Rolls of carton are housed in a cabinet underneath or next to the machine (fig. 674), each key controlling a roll with a capacity of 2,000 standard size tickets :

AUDITING. — The machine is fitted with a paper check band or ribbon, 1 3/4" wide (fig. 678) which shows all the information appearing on the 1 1/2" x 1 3/8" lower part of the ticket. Besides being wider than the ticket, it also shows on the left-hand side, the impression of the number of the stereo-plate which is also the number of the destination station. In addition, the ticket's serial number is printed in red on the check band above the other information; the initials of the category are printed on it in heavy black type.

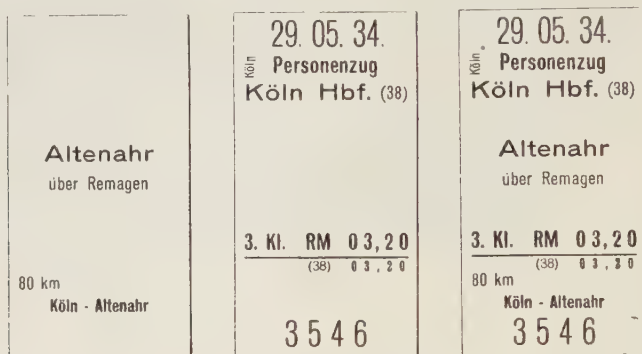


Fig. 677. — How the letterpress is apportioned between the *Pautze* machine's stereo-plate and rotary printer. (Red. 4/5).

A — Print from stereo-plate.

B — Print of the text by the machine.

C — Juxtaposition of texts printed by the stereo-plate and the machine's rotary printer.

2 1/4" by 1 3/8" and about 1/32" thick. This is thicker than the card used in Great Britain's rapid printers and a shade thinner than ordinary ticket carton.

Up to 25 identical tickets can be issued by merely pressing a button and, by pressing another, stocks of tickets can be printed at the rate of 30 a minute.

When a ticket is issued to a child, a portion of it is clipped off and serves, as a voucher against the granting of reduced fare.

The four previous impressions can be viewed simultaneously through a window in the machine-roll.

A TOTALISOR registers the cash and total amount taken; this is obtained through summarising the sums appearing on the check band. The sums paid between two issues of tickets are got by comparing the statements on the check band with the corresponding serial numbers of the tickets and vice-versa.

Sz
1818
3. Kl. RM 10,60
188 km
Köln - Bielefeld Hbf.
über Wuppertal

Ez
1819
2. Kl. RM 14,10
216 km
Köln - Bielefeld Hbf.
über Duisburg

Pz
1820
3. Kl. RM 06,20
154 km
Köln - Bingerbrück

So
1821
3. Kl. RM 04,50
84 km
Köln - Betzdorf (Sieg)

Ar
1822
3. Kl. RM 01,70
41 km
Köln - Euskirchen

EzZ
1823
2. Kl. RM 01,00
150 km
Köln EzZ - Zone II

— Sz = Schnellzug (Express).

— Ez = Eilzug (Semi-fast train).

— Pz = Personenzug (Slow).

— So = Sonntag (Sunday return).

— Ar = Arbeiter (Workmen's return).

— EzZ = Eilzug-Zuschlag (Semi-fast train zone supplement).

These strips are analysed in a central office.

An improved Pautze machine giving more statistical information is in use in

4402 1822 52
Poc. osobowy
K) Kraków 3)
Dąbrowa Górnicza
via Szopienice
Wjazd w dniu dotowania.
Ważny i dzień.
Ulgowy specjalny
3klz 01,10
84 km (3) 01,10
Kraków - Dąbrowa
Górnicza via Szopienice
- 4402

35.10.40
Festtagarückfahrk
Personenzug
Halle (Saale) (E)
Dresden
über Leipzig
andrück von einem durchgehenden
Nicht übertragbar
2. Kl. RM 12,40
158 km (E) 12,40
Halle - Dresden
4219

Edmondson Pautze machine carton tickets.
(Red. 4/5).

Fig. 679. — Polish State Railways — Ticket dated at top and numbered at both top and bottom.

Fig. 680. — Return ticket for public holiday, German *Reichsbahn* — With one serial number only.

g. 678. — Control strip of Pautze machine.
(Red. 3/4).

The small figures on the left relate to Administrations with which the *Reichsbahn* has account. The strip shows carriage class, price, distance, destination and route.

STATISTICS. — As each ticket is printed, paper strip is punched automatically in five columns. This reads as follows (Fig. 681) :

The three columns at the extreme left taken together constitute 3-figure numbers (hundreds, tens and units) which apply to the destination stations;

The next column gives the category;

The last one on the right, the class travelled in.

Hundreds.
Tens.
Units.
Category.
Class.

0	0	0	Pz	
1	0	1	K	
2	1	2	Ez	
3	2	3	Ex	
4	3	4	So	
5	4	5	Ar	
6	5	6	EzZ	
7	6	7	Ar	1
8	7	8	Ar	2
9	8	9	Ar	3
	9		Ar	

Fig. 681. — Statistical record strip to be punched by stops on the Pautze machine.

Cologne Station. Its capacity has been raised to 24 categories of tickets printed on 16 colours of carton.

The machine has totalisors for each denomination and one for each of the 5 zones of « Schnellzug » and « Eilzug » (express and semi-fast) supplements. In addition to totalising the issues for each type of ticket, there are money totals for each type of ticket sold giving the total debit of the machine subdivided into Schnellzug, Eilzug, etc. There are in all 57 counters to the machine.

An extra attachment produces statistics on separate cards on the Hollerith system. They are punched automatically as each ticket is issued and have the station number printed in Roman figures at the foot. Should it be necessary to analyse the kinds of issues to a particular station, all the cards for that station are put into a sorting machine and the code-number set by turning the key to the respective number shown in thousands, hundreds, tens and units. The release key is pressed and the amount printed on a sheet of paper within 20 seconds, the division being made into 44 kinds of tickets.

Special machines print and deliver season tickets. In this case again, each stereo-plate serves for 10 kinds of tickets.

E. The machine of the « Regina Maschinenfabrik », of Kalk, near Cologne, is noteworthy as it was the prototype of the A. E. G. machine, which is the most extensively used to day. It prints up to 2,000 different tickets and two check bands at the same time. Whereas when any composing unit of the « Contrôleur » checking machine is required, the chain and all the composing units have to be moved, any of the « Regina's » printing plates can be collected separately.

The machine delivered on September 1st, 1907, and fitted up in Cologne main station could print 1280 different kinds of tickets to 324 different destinations. These included

- 3rd class tickets for all trains;
- 3rd class tickets for semi-fast trains;
- 3rd class tickets for slow trains;
- Military tickets.
- Dog tickets.

The « Regina » machine was 3' 7 1/4" long, 1' 11 1/2" wide and 3' 11" high. No object would be served in giving a detailed description of the machine as it has been considerably improved since its first appearance. It will be sufficient to note that it was provided with a printing carriage which it was easy to bring opposite the destination plate with the carriage class required. As a handle was moved back or forwards, a system of levers brought the plate to the printing table and returned it, after use.

In 1910, similar machines made by *Festten* and *William Lahmeyer*, of Frankfurt were tested in Essen, Mainz and Stuttgart.

Other machines made by the *G. Göbel Ganderberg Machine Works*, of Darmstadt, embodied different principles.

All these machines — and this includes particularly the A. E. G. machine which we are about to describe — possess very considerable advantages.

Checking of all takings is reliable, and receipts are automatically recorded on check band whenever printing takes place, and the numbers, recorded by a meter, advance one unit when a serial number is printed on the ticket and the check band.

When taking up and leaving duty, the booking clerk prints a special number.

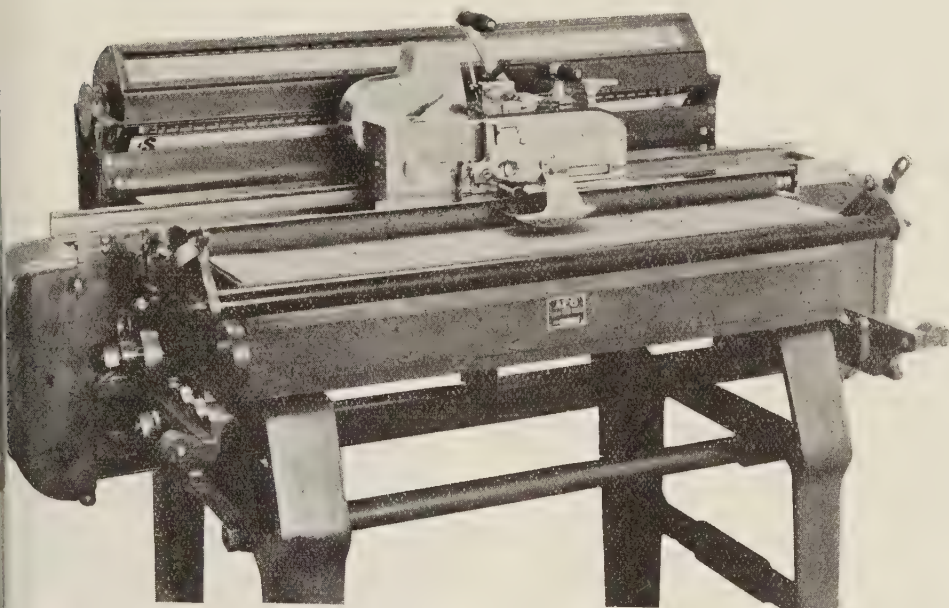


Fig. 682. — General view of A. E. G. multi-printer.

et which is attached to his invoices. s enables the auditing department to ve at the number of tickets he has led.

is impossible to sell tickets out of r proper order. The Company is ected against fraud and the clerk sav- from being suspected.

he two control strips offer a double antee. By means of these strips, ac- ats are quickly made up, and as no is lost in checking when the clerk off duty, the booking office need r be closed. The machine can even

be taken over in an instant by any of his colleagues.

Accounting is of the utmost simplicity as the receipts totalisor always states the debit of the machine.

F. The A. E. G. ⁽¹⁾ multi-printer machine for printing and issuing Edmondson tickets has been described in a number of technical journals, the authors having more especially dealt with the machines used on their own line ⁽²⁾. We have endeavoured to take the matter up from a broader standpoint, extra infor-

1) *Allgemeine Elektrizitäts Gesellschaft.*

2) See the *Génie Civil*, January 25, 1930; *Revue Générale des Chemins de fer*, April June, 1932, article by Legoux; *The Railway Gazette*, May 3rd, 1935; *Bulletin of the Railway Congress*, June 1935, article by A. Deprez.

mation having been kindly supplied to us by Mr. Chaperon, Chief of the French Nord's Administrative Services, the late Mr. Deprez, of the *Belgian National Rys. Co.*, Mr. Gibbons, of the *London and North Eastern Ry.*, and the builders of the *A. E. G.* machines, to all of whom we express our thanks. We have also made use of a report by A. E. Turner Esq., to the *Victorian State Rys.*

As we have stated, the prototype of these machines was supplied to the *Prussian State Rys.* in 1907. A few years later, a large-scale trial of 100 of these machines took place and, in 1926, the *Reichsbahn* was using 1,200 of them. This figure has now been increased to some 3,000, 2,450 of which are in use in Germany and 300 in France.

The machine comprises

A main- or underframe which carries the plate magazine;

An upper or sliding frame used for selecting the printing plates;

The station index « prism » or « Polygon »;

A printing carriage which simultaneously

picks up the plate, prints and issues the ticket and keeps the accounts.

The accounting and statistical portions comprise

The control strips;

The dissector;

The totaliser unit.

We shall consider these various items in the above order.

The UNDERFRAME is robust and made of cast iron. It contains a plate magazine whose size varies with the number of different tickets the machine is to deal with.

This MAGAZINE contains from one to eight horizontal compartments placed one behind another, all being provided with rows of vertical grooves for sliding plates in. The grooves are spaced at 150 mm. (1 1/4"); a compartment 150 mm. (5/8") long therefore holds 250 2-mm. (5/64") thick steel plates. The machines are made in 7 standard sizes to hold from 100 to 2,500 plates and their overall dimensions vary accordingly :

Number of plates :	100	200	500	1,000	1,500	2,000	2,500
Length	3' 6"	3' 6"	4' 3"	4' 3"	5' 5"	6' 8"	8' 0"
Height	1' 2"	1' 2"	3' 7"	3' 7"	3' 7"	3' 7"	3' 7"
Depth	1' 0"	1' 3"	2' 4"	3' 0"	3' 0"	3' 0"	3' 0"

The machines having from 1,000 to 2,500 plates are all 3' 7" high and 3' deep; their length alone varies. Most of our illustrations refer to the 1,000 eight-compartment magazine machine (particularly fig. 683).

The PLATES have been given a very special shape (fig. 684) so that they should be able to be locked in the magazine when not in use, or taken out and brought to the printer when necessary. The locking is done by a special shaped bar or spindle which extends along the whole compartment. When the printing

carriage is moved off a compartment, the bar is operated from a lock on the printing plates by means of a chain connection with the upper sliding frame. But a single row of plates is thus available at a time and only when the carriage is over it; the unemployed plates — save a single one of the row — are protected against outside interference by an endless metal band attached to the printing carriage.

The lower part of the vertical plates is hollowed out so as to allow the special shaped bar (half-round section) to pass

freely through them. Moving the upper frame and carriage causes the bar to rotate 90 degrees around its axis; its plane face takes up a vertical position, thus releasing all the plates of the compartment, which enables them to be withdrawn upwards. All the other compartment locking bars having remained in their original position, the plates they pass through are kept locked.

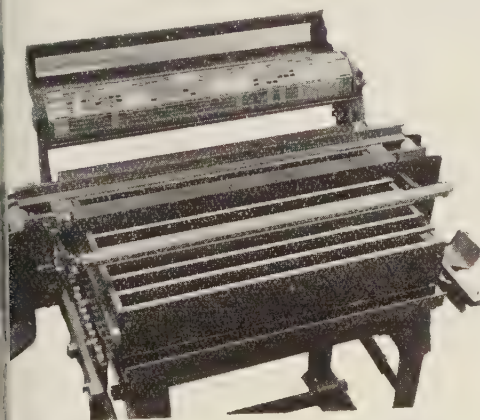


Fig. 683. — Arrangement of magazine showing longitudinal plate compartments.

The UPPER OR SLIDING FRAME which is mounted on rollers and supported by the main frame moves transversely. It consists of slide rails which guide and carry the printing carriage; these rails are spaced to the width of a plate compartment. By combining the transverse movement of the sliding upper frame and the lengthwise movement of the carriage, the plates can be brought exactly over any of the plates.

To accomplish this, the operator depresses a horizontal bar which extends from end to end of the machine and pushes or pulls it, thus causing the frame to move away or towards him, which brings the carriage over the row of plates which is required ⁽¹⁾. The actual location of the frame and Polygon is affected by a coarse pitch rack carried by the main frame.

The sliding frame carries what amounts to a plate index. This ingenious device, called a « PRISM » or « POLYGON » is a rotating unit with eight faces whose length is nearly as great as the sliding frame's and is placed at its back side and at a slighter higher level (fig. 683). Each face of the Polygon corresponds to one of the magazine's compartments and carries a strip of cardboard on which the plates are indexed in the order in which they are housed in their compartment ⁽²⁾. The Polygon revolves when the sliding frame which supports it is moved through a

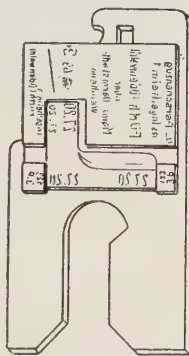


Fig. 684. — Printing and base plate, A. E. G. machine, with small separate fare plate.

(1) In this transverse movement, the carriage is kept in position by two spring-loaded rollers, one on each side of the machine, in such a way that it is always exactly over one of the compartments.

(2) These inscriptions usually state the destination, the plate number, the class (or category) and the fare.

fine pitch rack and pinion attachment from front to back or vice versa over the main frame.

At the moment a face becomes visible and set, the printing carriage is exactly over the row of plates to which that face of the Polygon refers.

The carriage bears a pointer and whilst the carriage moves lengthwise over the row of plates, the pointer which has been moved horizontally along the Polygon's face indicates the particular plate available for printing.

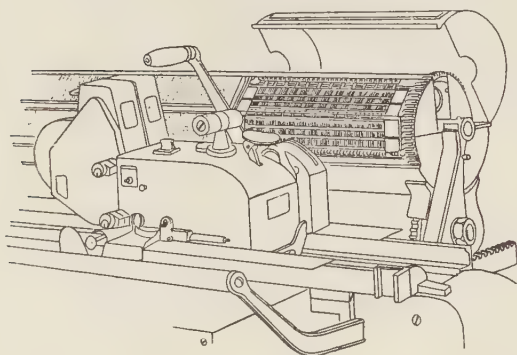


Fig. 685. — A. E. G. machine — Arrangement of « polygon » and printing carriage.

The PRINTING CARRIAGE is a complex unit which does the actual printing (fig. 685). It has been gradually improved and elaborated so that there are now three means of working it :

(a) Hand operation and feed, with two control strip unit attachments;

(b) Power and hand operation, hand feed with either 2 control strip units or one control strip unit and totalisator unit;

(c) Power and hand operation, feed from carton roll, with control strip unit and totalisator.

We have seen how the printing carriage is moved lengthwise by hand, run-

ning on ball bearing rollers located within channel guides which are actually part of the upper sliding frame. It can thus be brought over any plate of the magazine, where it becomes automatically locked. This is obtained by pressing a push button which controls a catch engaging in the groove of the compartment adjacent to that of the plate to be used. When the plate has been accurately selected by means of the pointer, the button is released and the carriage locked.

The printing carriage contains

The mechanism for printing and for inking the plates;

The mechanism for numbering the tickets serially;

A movable printing dater;

Occasionally, the means of printing the word « return ».

It also contains two control strip units, one of which has been replaced, in later machines, by a totalisator.

PRINTING THE TICKET is accomplished by the to and fro movement of a lever keyed on the main spindle of the printing mechanism. A locking arrangement prevents this lever being moved before the blank carton has been brought to its proper place.

During the first part of its stroke, the lever actuates a device called the « butterfly » which picks the plate out of the magazine. It also operates a combination of mechanisms which bring the several printing elements together in front of the ticket and check strips and in the proper order, viz. : the plate, the date stamp, the control numbers, the « return » stamp, etc. The actual printing occurs when the lever reaches the end of its stroke.

During the second part of its stroke, the lever again actuates the « butterfly » which returns the plate into the magazine.

and operates the mechanism that ejects the ticket.

The later machines have electric control instead of hand operation and automatic carton feed straight from the roll. The second part of their lever's movement actuates a cutter so as to sever the printed ticket to the proper length.

The carriage also contains a NUMBERING MECHANISM for printing the same serial number on the ticket and on the control strip, and a DATE STAMP.

All the printing elements are INKED by three rollers, one large and two small, mounted in the carriage. The larger roller moves over the face of the plate as it is being raised; the two smaller ones, which are inked by the large roller, ink the Numerator and the Dating Stamp.

The PRINTING PLATES are built up in three pieces (fig. 684) :

A baseplate on which are mounted the two rollers;

A letterpress plate;

And, usually, a detachable plate carrying fare indications and totaliser control pins.

The sides of the baseplate engage in the plate magazine's grooves; it is slotted from the bottom upwards so as to allow plate interlocking. The upper hook enables the plate to be lifted for printing, and the square hole allows it to be held rigidly in position by a dowel plunger whilst printing.

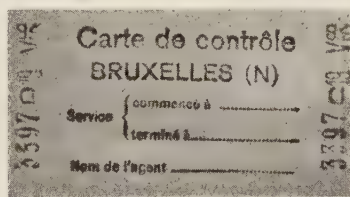
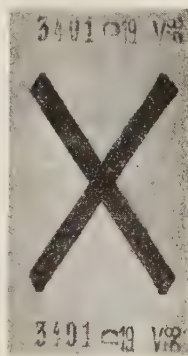
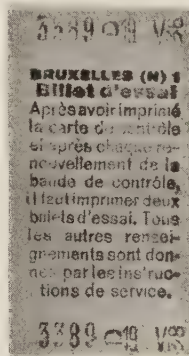
The letterpress plate which is sweated to the larger baseplate contains all the elements to be printed on the ticket with the exception of :

a) the date and number which are printed by two separate devices contained in the carriage;

b) the fare which is printed by a

small plate inserted in the main printing plate.

It is usually separated from its parent plate so that fares may be altered by substituting another small and inexpensive fare plate to the existing one, otherwise the entire plate would have to be sacrificed. As all fares are generally altered



Auxiliary tickets for A. E. G. machines.
(Red. 4/5) — *Belgian National Railways Co.*
Fig. 686. — Test ticket.
Fig. 687. — Ticket printed from dummy plate.
Fig. 688. — Control ticket.

at the same time, the exchangeable fare plate can generally be used for another plate which is a very simple operation any skilled mechanic can perform. Fare plates usually bear the fare in duplicate so as to print it on either side of a dotted line when return tickets comprise two portions.

When a totaliser is attached to the

pletely enclosed type. The mechanical counters fitted to them are inaccessible to the booking clerk.

Each strip is good for 7,000 impressions. A red stripe runs down the end of the strip along a distance corresponding to about 25 ticket impressions, and when the strip actually runs out, a red signal appears at the top of the unit.

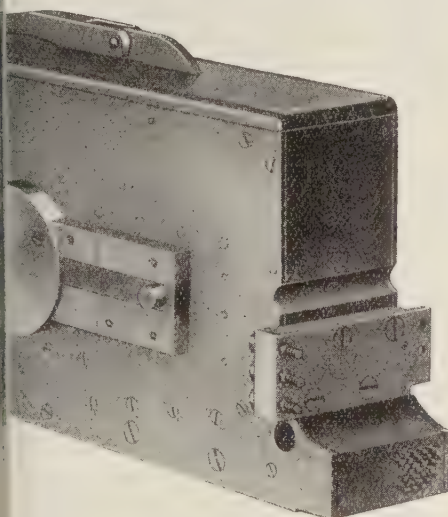


Fig. 691. — External view of A. E. G. totalisator.

The DISSECTOR was devised for compiling statistics mechanically or clear for bookings which otherwise would not be counted on the control strips. By this means, each separate ticket is classified and registered in connection with printing. Each of the counters is related to a single plate in the magazine records by means of four digits

counting from 0 to 9,999, the number of tickets printed by that particular plate.

Under each counter, a small interchangeable number plate is attached, bearing the number of the printing plate for which the particular counter is intended.

These counters being small and compact, they are mounted in groups of three referring to adjacent stations. They are usually grouped at one end of the Polygon and equally distributed on all sides (fig. 685). The rows of sliding pins protrude on the lower edges of the sides, and over the counters themselves are fixed detachable station indices. Twelve triple units are usually built into each of the 8 sides of the Polygon, making 288 counters in all.

The readings are obtained off them by rolling an impression roller, containing a roll of paper and a roll of carbon paper, over the face of a row of counters so as to obtain a first hand impression.

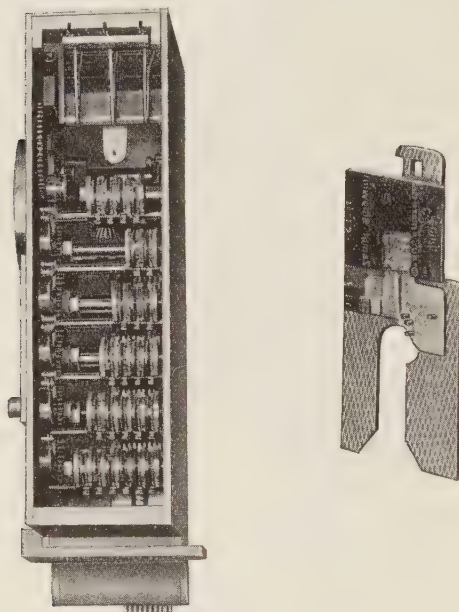
After arriving at 9,999, the counters return automatically to zero.

The TOTALISOR UNIT (fig. 691). — Instead of counting the tickets of one of the control strips and checking the results by means of the other, a totalisator may be substituted for one of the control strip units ⁽¹⁾ the other, of the open type, being attached to the printing carriage close to the totalisator.

This unit totalises all the control strip fares so as to relieve the booking clerk. As with the control unit, the cash position can be determined at any time by taking readings by means of a small paper strip which is inserted for the purpose into the totalisator, and taking a

⁽¹⁾ On the lower part of the totalisator which is encased in the printing carriage, there is a projection in which 37 pins can slide. The fare plates fixed to the printing plates are fitted with studs 2 mm. (about 5/64") long whose number and spacing depend on the fare.

pressing off the figures. The two control cards giving the number of tickets issued on taking up and leaving work, two readings of totalisor strips give the corresponding cash position (fig. 689).



A. E. G. machine.

Fig. 692a. — Receipts totalisor — Cover removed so as to show the six counters.

Fig. 692b. — Special plate holder used with totalisor.

The totalisor itself contains six counters (fig. 692) which are controlled by pins projecting slightly from the front of the totaliser case. These pins come into contact, at the moment of printing, with similar pins arranged on the printing plate. At the same time, the totalisor unit moves forward in a quick sliding action into the printing carriage so as to bring about the contact of counter pins with those of the printing plate from which a ticket is printed.

The first of the six counters is a five disc numerator which adds one unit whenever a ticket is printed. Its result must tally with those of the printing carriage.

The five other counters record the hundreds, the tens, the units, the dim and the centimes or similar amounts in British currency. To avoid uselessly complicating the totalisor, these amounts are not added to each other in the totalisor unit. Instead, whenever it is required, a slip of paper with its carbon duplicate is introduced into a slot provided for this purpose in the front of the totalisor and a lever is raised at the top; the counter numerals are pressed on the carbon paper which prints the record. The first upper number is the highest ticket series number; the five others, the hundreds, tens, etc. A simple addition gives the grand total.

The totalisor has a number of advantages :

No need to add figures of the control strips.

The cash position can be obtained in a few minutes and the sums checked at any time.

Clerical errors are easily detected;

There is absolute security from tampering.

Portable A. E. G. multi-printers handle from 100 to 200 printing plates on one machine. They differ from those we have discussed in that the lower frame is not mounted on special iron rails but is fitted with handles on each end for carrying it.

The usual sizes are :

Length 3' 5 3/4" (1060 mm.) by 11 7/8" (300 mm.) wide;

Length 3' 6" (1070 mm.) by 14 1/2" (368 mm.) wide;

Their weight is 110 and 140 lb. respectively.

They are fitted with the usual printing carriage, dissector and other appliances.

which are to be found on the larger multi-printers.

Utilisation of the A. E. G. machine. — Although the machines used by the different railways are similar, their tickets are not, each Company having its own standards which must be adapted to the machine if it is to be used to the best advantage. The number of tickets and of categories must be taken into consideration. The issue of blank tickets, which are a cause of error, despite constant checking and supervision, should be reduced.

Certain general considerations apply to all Edmondson tickets used in the A. E. G. machines. Whereas the standard size of 2 1/4" by 1 3/16" has been kept, automatically fed multi-printers use card not less than 0.018" nor more than 0.025" thick. Both the *London Passenger Transport Board* and the *London and North Eastern Ry.* have adopted 0.018". Hand-fed multi-printers use card 0.03" thick, approximately the standard thickness of the usual pre-printed tickets.

A number of other problems are also raised when mechanising booking offices. The tickets being printed on one side only, the space for the letterpress is restricted.

The question of colour must also be taken into, for when the machines are automatically fed, it is not possible to use anything but card roll of a single colour. When this is the case, the letterpress must clearly show the class travelled in, usually by means of large numerals (figs. 703a, 704a) and the category, either by large strokes for various tariffs such as half- or quarter-fare (figs. 701, 702) or by clear initials, or vignettes (fig. 705a) for other categories. A further problem, when feeding the blank cartons by



A. E. G. machine Edmondson tickets.
(Red. 4/5).

Fig. 693. — South African Railways return ticket — Two halves separated by dotted line.

Fig. 694. — Netherlands Rys. single ticket — Separable into two halves for half-fare.

Fig. 695. — Indian ticket, with oblique separation allowing the halves to be used at half fare.

hand, consists in pre-printing these designations in red (figs. 230, 699). Notices and other indications may also be printed in advance on the back of the tickets (fig. 698). Many Companies have kept to their usual colours and therefore have to feed the cartons into the machines by hand.

Return tickets raise another point, for they can be printed as one- or two-piece tickets, either system having far reaching results which we deal with at length in Part E.

But whatever the Company's decision, it reacts on the machines. When one-piece returns are used, they need be dated and numbered once only. When comprising two portions, it is considered advisable to date and number both halves, and this takes up room even if the date be printed in small type on the same line as the serial number. This double dating also weakens the plates slightly.

Ordinary tickets usually have the number at the top and the date at the bottom, or vice-versa (figs. 702, 704a).

The *L. N. E. Ry.* has adopted still another practice, for even on two-piece return tickets, it only prints the date once, and that on the return portion. Whilst the two portions are joined together, there is no object in double printing it, and the date appears on the return portion which is the only one that is available for travelling after the ticket has been halved.

Two-piece return tickets may be divided into two halves (figs. 693, 694, 710) or into two unequal portions, generally two-thirds and one third of the ticket (fig. 703b). This latter division is recommended as allowing an easier and clearer arrangement of the letterpress.

It would serve no useful purpose to go into the way every Company has adapted its system of ticketing to the machines. But it is indispensable that we show how some of them have done so, under widely different conditions. It proves the adaptability of the machines and shows that widely different methods can apply, with far-reaching results, according to the way they are used.

We shall therefore take five characteristic Systems : the *Belgian National Rys. Co.*, the French *Est and Nord Railways*, the *London and North Eastern Ry.*, and the German *Reichsbahn*.

A. A. E. G. machines on the *Belgian National Rys. Co.* — The number of different categories of tickets has been reduced to 33 for home traffic :

Full fare singles and returns;
Single and return tickets with a 25, 35, 50 or 75 per cent reduction;
Week end tickets.

This brings the total up to 11 and for the three classes, to 33. All these tickets are issued to each of the System's 1,400 stations, making a total of 46,200 different tickets.

This inconvenient number has been curtailed by four means.

(a) Every ticket can be issued at full fare or at any of the reduced fares. For this purpose, each of the various reductions is listed together with the corresponding fare (fig. 231). The ticket is bisected horizontally immediately below the desired percentage, the upper portion which shows the percentage applied being delivered to the passenger and the stub retained as a voucher by the booking

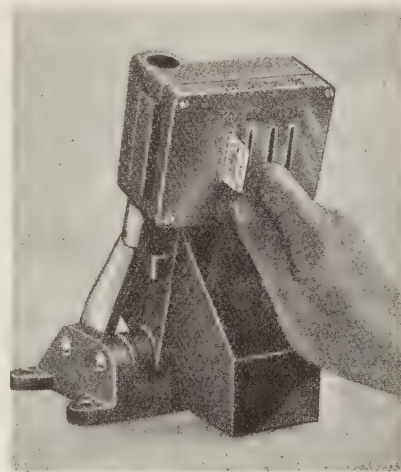
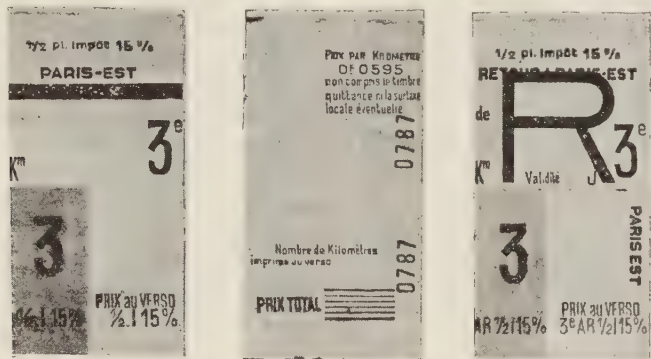


Fig. 696. — Apparatus for sectioning multiple-percentage tickets to lengths varying according to the fare percentage — *Belgian National Railways Co.*



Front and back of semi-blanks partly pre-printed in red for 3rd-class « type-tickets » of the French *Est Ry.* — This pre-printing is in red. (Red. 4/5).

Figs. 697, 699. — Front of single and return tickets.

Fig. 698 (in centre). — Back of both single and return tickets.

Figures 232 to 235 show the same tickets fully printed with remaining text in black.

k. Bisecting takes place in a special meter with four slots whose depths correspond to each of the percentages indicated on the ticket (fig. 696).

b) Scheme or multi-destination tickets are good to one of three destinations listed on them; they are provided with a « grid » for writing in the name of any other of lesser importance or of a halt, should an extra one be inserted to allow light « T » trains to compete with road traffic.

c) 3-km. (1.86 miles) zones have been established beyond a certain distance and 5-km. (3.1 miles) zones beyond. This has been merged a number of ticket fares.

d) Two different ways of dealing with return and week end tickets have been introduced according to the destinations to which they are often or seldom asked for.

The former are printed by special return or week-end plates. The latter are the tickets printed on blank cards already pre-printed in red with the letters R and T interlaced (« R » for return and

« T » for its Flemish translation, « terug ») and are issued two tickets at the time, one for the outer, the other for the return journey, there being no reduction on full-fare return tickets.

This has enabled all categories of tickets to be delivered at Brussels-Nord to 1,400 different stations by means of 1,200 instead of the 2,000 plates the larger machines originally had. Tickets for which there are no plates are dealt with as set out above. In practice, this is very much the exception, as the following statement shows :

8 tickets per thousand are bisected;

An extra name is written in the grid on 1 per cent of the tickets;

3 per cent of the returns are issued in the shape of two single tickets.

Seven machines occupying an area of 6' 8" by 3' 1/2", and 3' 7" high, deal with the work previously done by 11 booking clerks and windows, 7 of which had a duplicate series of booking racks to accelerate taking over.

The Belgian system deserves very special notice owing to its simplicity.

B. A. E. G. machines on the French *Est Ry.* ⁽¹⁾ (*figs. 232 to 235*). — There are 18 categories of passenger tickets in France :

- Full-fare tickets;
- Reduced-fare tickets issued with a reduction of 30, 40, 50, 60 or 70 p. c.;
- Free passes;
- Privilege tickets issued at a quarter- or half-fare.

All these are issued single or return, bringing their number up to 36 and, for the 3 carriage classes, to 108. With single and return dog tickets the grand total reaches 110.

Identical serial numbers appear on the back of both portions of a return ticket. The number on the front is a serial number referring to the pre-printed cartons and would be insufficient for the identification of a return portion with the original ticket. This difficulty could have been got round if the pre-printed number appeared on both upper and lower portions of all tickets, return or not. But then, it would not be possible to discriminate between returns and singles, the same cartons being used for either.

BLANKS. — The number of plates having been limited, those tickets for which no plates had been provided are issued as plate-printed semi-blanks on which the fare only was written in by hand. This is the most ingenious feature of the *Est* tickets.

Blanks which are such thorns in the side of all booking-office auditors, are

here dealt with in three stages. In the first-stage, so-called « Type-tickets » of which part of the letterpress has been pre-printed are selected; next semi-blank destination plates print most of the other items and to finish up, the fare is written in by hand.

The particulars concerning the passenger are always the same, so they can be pre-printed, whereas those depending on the destination differ in each case and must be attended to separately. A limited number of different kinds of tickets are all that need be pre-printed and they only acquire a value as tickets when the extra items will have been added to them.

The cartons on which general information has been pre-printed in red are called **TYPE-TICKETS**. They all bear the following information :

- Class of carriage;
- Single or return;
- They state whether the tariff is a full fare, one, or the percentage of reduced fare applicable.

There is also a **SEMI-BLANK PLATE** for every destination, printing :

- The destination;
- The route followed;
- The distance in kilometres;
- The number of days the return portion is available;
- Occasionally, other information as well.

The third and last stage consists, as we have seen, in adding the fare which is written in by hand.

So a single printing with the Semi-blank destination plate (the *Est*'s so-called « cliché-passe-partout ») on one of the partly pre-printed **TYPE-TICKETS** tu

(2) For further details, see the excellent article by Mr. Legoux, in the *Revue générale des Chemins de fer* for April and June, 1932, from which certain particulars are taken.

a complete ticket. Mr. Legoux points out that out of the total number of tickets issued in Paris-Est station in 1932, 8 per cent of the main-line, and 4 per cent of the local tickets only were so issued.

There are two kinds of Type-tickets, one for singles, the other for returns (Nos. 697 to 699). In each case, there are different Type-tickets for each reduction, each class and each category. All are on the left lower-side, a coloured band which is to be punched out.

On the other hand, there is but one SEMI-BLANK destination plate.

This is a 1st class full-fare return ticket which adds black letterpress to the red plate-printed Type-tickets. This plate is as follows:

The destination on both parts of the ticket;
The distance, on the upper portion and the stub;
The price (1st class, full-fare), on the stub;
The period of availability, on the upper portion of the ticket.

And the machine adds:

The serial number, on the upper part and the stub;
The date, on both parts of the ticket;
The machine's check-letter, immediately before the date.

Up to now, the ticket therefore includes the following data:

On the upper portion, in red:
The class;
The letter R (return);
The fare reduction, in percentage;
On the lower part, also in red:
The printings of the above;
The caption « See price at back »;
On the stub, in red:
The printings of the above;
On the stub, in black:
The 1st class full return fare.

The only item that is not on the ticket yet is the fare with a percentage reduction when there is one. This fare is read by the booking-clerk out of specially prepared tables where the fares are arranged on a distance basis; he then writes it twice, first on the back of the ticket he hands the passenger and next, on the front of the stub he retains. The passenger may check this fare by means of information pre-printed in red on the back of the ticket, where he finds the price per kilometre, minus the value of the duty and local taxation if any, and which he multiplies by the number of kilometres printed on the ticket's face.

The issue of a ticket therefore comprises the following series of operations:

Taking a type-ticket;
Printing it with a semi-blank destination plate;
Reading the fare off the tables;
Writing the fare on the back of the ticket and on the stub;
Punching out the stub which is to remain as a voucher.

HALTS. — Both the *Belgian National Rys.* and the *Est* use plate-printed tickets for halts and both complete them, the one by hand, the other by further plate-printing. In Belgium, the name of an extra-halt is added by hand on a ticket of the same category and same distance.

On the *Est*, a ticket is printed in the usual way to the nearest destination for which a plate exists, this place being dubbed « gare de rattachement » which can be freely translated as « parent station », and this ticket is validated from the parent station to destination by an extra-printing with special « *Extension of journey plates* ».

The back of the tickets is already pre-printed in red with the price per kilo-

metre (whose use we have stated) and a grid for writing in the fare. The « Extension of journey plate » simply adds, this time in black, the extra number of kilometres from the parent station to the destination halt, this number being used on any category of ticket and for any other extra trip of the same length. The clerk then writes in the name of the halt and the total fare.

To do this quickly and without calculation, he reads off in a « List of stations having no plate » the name of the nearest parent station for which a plate exists, the extra number of kilometres as far as the halt (for which there is an « extension of journey » plate), and the total amount of the fare.

This system is certainly a most ingenious one but it is less simple and slower than the Belgian. It is useful to the passenger but less so to the Railway Co. as it does not give the total machine's debit either by the control strips or the totalisor.

C. The A. E. G. machines, on the *Nord Ry.*, are used differently, and for this very reason. All takings appear completely on the documents prepared by the machines themselves but on the other hand, a few blank tickets have to be filled in by hand. That this is no great drawback was proved in 1936 when investigations showed these only amounted to 1.41 per cent of all tickets sold ⁽¹⁾.

The *Nord* has applied two rules of its own, the one to the tickets, the other to its machines.

15 kinds of carton only are used :

Singles, 1st, 2nd, and 3rd class	
Returns, 1st, 2nd, and 3rd class	
International Belgian, 1st, 2nd, and 3rd class.	
Paid leave	
Congresses	
Resorts, 40 days validity, 3 classes	
Dogs	

So far, the following 5 kinds of carton had been used for each class :

- Fully coloured according to the class, full-fare tickets;
- Bi-coloured with vertical division, for half-fares;
- Bi-coloured with diagonal division for quarter-fares;
- White card for dogs;
- Two-piece cards for returns.

There were therefore 13 kinds of carton, all differently coloured.

These 13 have been reduced to 3, one for each class, and coloured according to the class. Instead of distinguishing the various categories by different arrangements of colour scheme, they are distinguished by black printed markings. Half-fares shown by a thick vertical bar; quarter-fare, by an oblique one; returns by a large letter R; and dogs, by a vignette (figs. 700 to 702 and 703a).

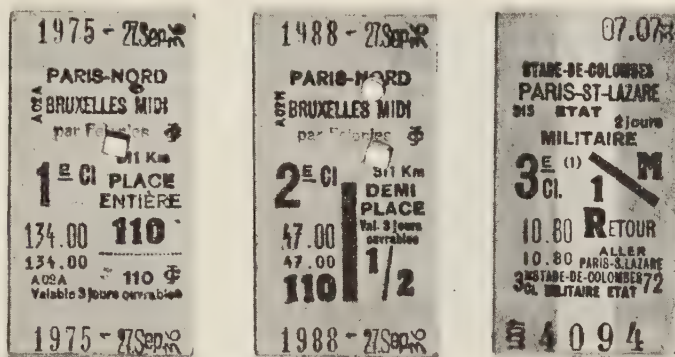
On the other hand, the machines have been specialised and set up in groups, each only issuing certain of the tickets that have to be provided.

The 1st and 2nd groups issue 1st, 2nd and 3rd-class main line tickets, to all places up to a fictitious line drawn through Beauvais, Clermont, Compiègne, and Villers-Cotteret.

This new arrangement has supplanted

(1) This can be apportioned as under among the groups of machines :

2.4 per cent, main lines, 1st and 2nd classes;	7.78 per cent, large families and disabled persons;
3.0 per cent, main lines, 3rd class;	diapers with 30 to 75 per cent, fare reduction.
0.08 per cent, suburban, all classes;	
0.8 per cent, through and local.	



A. E. G. machine tickets used on French Railways. (Red. 4/5).

Fig. 700. — Full-fare ticket, *Nord Railway* — International Convention monogram « C. I. ».

Fig. 701. — Half-fare ticket distinguished by vertical bar — International Convention — Same Railway — Dated and numbered top and bottom.

Fig. 702. — Quarter-fare return ticket (military, oblique bar) — *French State Railways* — Dated and numbered once only.

older one grouping St. Quentin, the main lines and Soissons.

The 3rd and 4th groups issue all class local suburban tickets:

The 5th group issues through tickets only;

The 6th and last, tickets for large families and disabled soldiers.

The number of booking office windows

Paris-Nord station has thus been brought down from 56 to 44.

Actual practice has still further specialised the machines which seldom use the 15 kinds of carton that have been retained. Thus the 3rd-class suburban machines only use 3 of them (single, return and dogs), the 1st and 2nd-class main-line machines, 7 only, and so on.

Besides this, the demand varies according to category and other reasons, so different size machines comply with the different needs. Whilst the greater number

have a capacity of 1,500 or 1,000 plates (12 machines of the former, 9 of the latter), 3 others have 2,000 and others still, 200 only. These are transportable and can be worked in pairs with others, so that during the slack hours, a single clerk working on one of the specialised machines may issue practically any ticket that may be demanded ⁽¹⁾.

Another feature of the *Nord* machines, as the Polygon shows, is that the plates have not been arranged in strictly alphabetical order particularly in the main-line and the suburban machines. The polygon's faces list groups of plates instead :

TICKETS.	Main stations.	Small stations.
Singles	Face 1.	Face 5.
Returns	Face 2.	Face 6.
Half fares	Face 3.	Face 7.
Quarter fares	Face 4.	Face 8.

(1) As the printing carriage is the actual printer carrying the control-strip and the totaliser, and as this carriage may work over different magazines, the *Nord Ry.*'s accountancy debits each carriage and not, as elsewhere, each machine.



A. E. G. machine tickets used on *French State Rys.* with stub one third the size of the ticket. (Red. 4/5).

Fig. 703a. Return ticket to greyhound racecourse — Dog vignettes.

Fig. 703b. — Return ticket for extended period of availability.

The stations are arranged alphabetically in the groups, a main station shown tenth, let us say, on the first face of the Polygon, is also tenth on the 2nd, 3rd



A. E. G. machine tickets used on *L. N. E. R.* (Red. 4/5) — Large numeral indicates the class of carriage.

Fig. 704a. — Reduced-fare return ticket.

Fig. 704b. — Single ticket — Plate number above ticket number at the lower part of the ticket.

and 4th faces, hence the printing carriage need not be moved as far when the passenger buys different category tickets for the same destination, as would otherwise be the case.

It is unnecessary to establish statistics for the smaller stations, so only the main station plates work counters whose showings are taken periodically on 4 bands (for 4 faces) instead of 8.

Automatic carton feed has further increased the speed of issue which has been worked out at 3 min. 30 sec. for hand-fed A. E. G. machines, and 2 min. 45 sec. for those with automatic feed, as against 3 min. 45 sec. per 50 rack pre-printed tickets.

D. The A. E. G. machines used on the *L. N. E. Ry.* — This Company has altered its tickets to suit the machines. As the feed is automatic, it has had to adopt a single colour instead of the variously coloured tickets that previously helped collectors to differentiate between the various categories. The new colour had to be different from that of any of the other tickets, so the Company's choice fell on a pale mauve.

In consequence, the category had henceforward to be indicated by letterpress only. The class of ticket, whether first, third, dog, cycle, or so on, is indicated on the extreme right-hand side, by a large numeral in the first instance, by initials in the second. The category, such as single, return, cheap day excursion and so on, is inscribed in bold letters at the head immediately under the Company's initials. Where the zone system applies, as many as four destinations are printed on the same ticket.

Another alteration is due to the front only of the ticket being printed by the machines. Such information as previous-

appeared on the back and which could be omitted has therefore been brought on to the front.

The items printed by the plate compose, from top to bottom, in the case of single tickets :

the Company's initials;
the Category of ticket;
indications such as : « Not transferable » — issued subject to the conditions in the Company's time tables »;
the station of departure and of arrival, and possibly route indication;
the fare;
the period of validity, such as « Available three days including day of issue ».

The identification marks are the plate number (in front of the Company's initials) and the number of the machine immediately following the name of the departure station).

Should the text appearing under (c) and have been omitted, the tickets would have been exceptionally clear (fig. 704b). These tickets are dated at the top in the usual manner, and serially numbered at bottom.

RETURN TICKETS are in two portions, outward or lower one being the smaller⁽¹⁾ (fig. 704b). The larger, or return portion is practically identical with single ticket, save that the matter is reversed.

The outer portion has only three lines of text.

In the first, the fare is repeated in small type immediately under the dotted line which separates it from the fare printed on the return portion, and this is followed by the name of the departure station (and number of machine);

In the second line is the destination (with number);

On the third line, further text stating validity and finishing up with a code block letter referring to the kind of ticket as C for « cheap day return »; M, for « Monthly return », and so on.

This ticket also is well devised and clear. It is dated and numbered as are the single tickets.

E. The A. E. G. machines are used on the *Reichsbahn* by several booking clerks. So as to enable the printing carriage to be worked by anyone and yet be able to check its working and audit all accounts during that time, a new attachment which is a movable control strip unit, has been devised. This takes the place of the usual second strip control unit fitted to hand-fed machines or of the totalisor on automatically fed ones. It also acts as a safety lock (fig. 705).

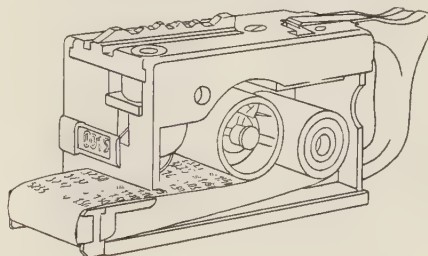


Fig. 705. — Removable control unit.

Not only does this allow different booking clerks to work the same printing carriage without extra checking or auditing, but the number of machines of the larger stations can moreover be reduced.

No ticket can be printed unless one of these personal movable control units be fixed to the printing carriage. There may be as many as 12 of these alternative

⁽¹⁾ Save dog, bicycle, etc., return tickets which are of a new one-piece type.

units to each machine, but in practice there are seldom more than 5 or 6.

Their working is simple. A lever actuates a notched rod that blocks the unit in the carriage; pressing the lever afterwards releases the unit.

The unit contains two rollers. A control strip is unreeled off the first one, printed with the particulars of tickets issued and reeled onto the second roller. There is also a ticket counter.

Each unit has its own distinctive symbol, often a letter of the alphabet. This same symbol is printed on the carriage's usual control strip, instead of the thousands numerals; this shows which of the personal movable units was in use when the tickets were printed. Portions of the ordinary and of the movable unit's control strips are shown in figure 706.

14.— ¹⁴ / ₁₀₀	B 775	3777	⁵ / ₁₀₀	5.10
— .75 ³ / ₄	E 776	3779	²⁵ / ₁₀₀	9.70
5.10 ⁵ / ₁₀₀	F 777	3780	²⁵ / ₁₀₀	2.—
11.— ¹¹ / ₁₀₀	B 778	3782	¹⁰⁰ / ₁₀₀	— .20
9.70 ⁹⁷ / ₁₀₀	F 779	3785	⁵ / ₁₀₀	23.20
2.— ² / ₁₀₀	F 780	3789	⁵³ / ₁₀₀	9.70
— .60 ³ / ₅	B 781	3789	⁵³ / ₁₀₀	9.70
— .20 ¹ / ₅	F 782	3790	⁵³ / ₁₀₀	9.70
1.— ¹ / ₁₀₀	B 783	3791	⁵³ / ₁₀₀	2.—
1.20 ¹² / ₁₀₀	A 784			
23.20 ²³² / ₁₀₀	F 785			
— .60 ³ / ₅	B 786			
3.— ³ / ₁₀₀	E 787			
— .85 ⁸⁵ / ₁₀₀	B 788			
9.70 ⁹⁷ / ₁₀₀	F 789			
9.70 ⁹⁷ / ₁₀₀	F 790			
2.— ² / ₁₀₀	F 791			
1.50 ¹⁵ / ₁₀₀	A 792			

Fig. 706. — General and individual control bands — German *Reichsbahn* — A. E. G. machine.

Like the *Nord* and *Belgian National Rys.*, the *Reichsbahn* has sought to diminish the number of machines and of plates but, unlike the former, has

brought quite different ideas to bear on the problem. These individual control units solve the problem in two distinct cases in the smaller or larger stations of the system, for in the former, these units provide against any necessity of specialising the work of the staff, and in the latter, they allow of specialising the machines.

In a small station, the machine is only in use a few hours a day and as the staff is scanty, any one should be able to run the machine at odd moments. The personal control units enable this to be done without any of the staff being saddled with errors they have not committed.

On the other hand, medium-sized machines only need be purchased for larger stations where they would deal largely with the more usual tickets by means of a greatly reduced number of plates. A single large-size machine would provide besides and any of the staff might work it in turn when he needs it. A machine is not provided with

The *Reichsbahn* has found that 90 per cent of the tickets issued by its large A. E. G. machines were printed by per cent only of the plates. Five small machines with personal control units and a single 2,000- or 2,500-plate machine

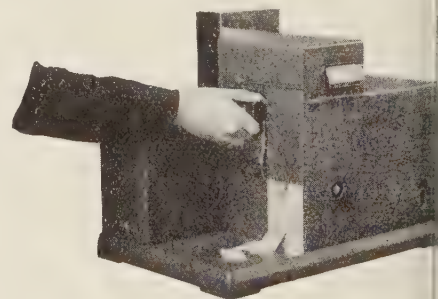


Fig. 707. — « Reduced » A. E. G. machine.

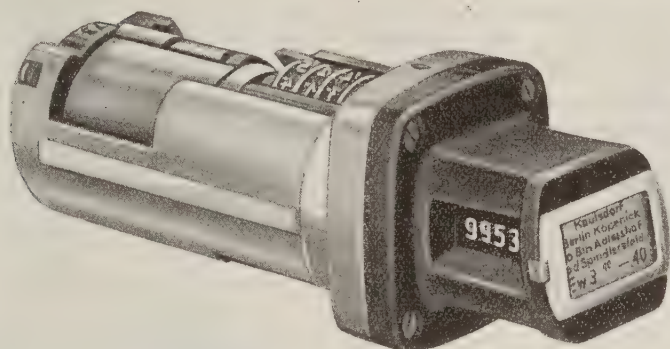


Fig. 708. — Cylindrical plate for « Reduced » A. E. G. machine.

would therefore do the work of five large 2,500-plate machines and would cost considerably less.

G. The A. E. G. « reduced » machine with cylindrical plates (A. E. G. « Baby Printer », fig. 707) differs from the former in that the plates are not stored in the machine. Like in the *Pautze*, they are stored in a cabinet at a handy distance from the machine, and labelled in front with their characteristics. But here the similitude ceases.

For the plates are cylindrical in shape, and the printing elements are protected by a tubular casing which precludes their being tampered with outside the machine (fig. 708). These plates play the part of blocks which can only be worked, after their introduction into the machine, by the keys the latter contains.

The tickets are numbered both by plate- and machine-printing, and separate ticket counters are provided on both the plate and the machine.

Two of these counters are fixed to the plates. The first counts the number of tickets printed with it and allows of di-

Tickets from « Reduced » A. E. G. machine.
(Red. 4/5).

Figs. 709, 710. — Single and return tickets
— French *Est Ry.*



rect reading; the other prints the serial number of the plate's destination station on the ticket. Besides this plate-printed number, the machine prints a general serial number whatever the kind of ticket and wherever it is available for. All the tickets the machine prints are counted by its own special counter.

There is no need to add a control strip as the counters with which each plate is

provided continuously furnish the number of tickets it has issued.

In connection with the machine's counter, there is a totaliser attachment giving the machine's cash debit. As with the larger machines, the position can be obtained at any time by inserting a strip of paper with carbon duplicator and getting a printing off the recorded amounts, by pressure.

Apart from this, the usual dating apparatus is provided.

The machines are automatically fed. The rolls of differently coloured carton are stored in the carton magazine, and similarly coloured labels attached to the front of the plates. When a plate is inserted in the machine, the whole magazine moves automatically across, so that the desired carton should be opposite the slot through which it must enter the machine so as to be printed.

Most of these machines are motor operated. The electrical connection is established in the machine when the plate is inserted and a slight rotary movement from left to right given it. If the motion ceases immediately, a single ticket is printed and ejected, but if the pressure on the plate be not relaxed, the machine continues to print and deliver tickets at the rate of 140 a minute.

When operating the machine by hand, a hand lever must be operated when the plate has been inserted.

There are a number of safety devices. The machine cannot start printing unless a safety key has released it; it cannot work without carton nor if the dater is not ready.

The most ingenious feature of the *A. E. G.* multi-printer is the Polygon; the most interesting here, are the important

functions of the cylindrical plates and the simple idea of a sliding magazine allowing of automatic feed of variously coloured cartons into the the same printer.

This « Baby printer » is particularly designated for working at high pressure in booking offices that only issue a limited number of different tickets.

CHAPTER XX.

EDMONDSON TICKET PRINTING AND ISSUING MACHINES (Contd.)

Non automatic machines having a separate printing cell for each destination.

We shall take the machines in the following order :

- H. The « Printix » machine;
- I. *Bell Punch and Co.'s* « S. P. » machine;
- J. The 1900 model Paris « Metropolitan Ry. » machine;
- K. The 1907 model Paris « Metropolitan Ry. » machine;
- L. The *A. E. G.* Rapid printer.

H. The « **T. I. M.** » ⁽¹⁾ **Printix** machine (figs. 712 and 713) is marketed by *Automaticket Ltd.*, London. In spite of its compactness — it is only 10" wide by 16" deep — it is possible to incorporate in the machine printing stereos for several different tickets.

The « Printix » is electrically driven by any electric light current or by a motor of about 1/10 B. H. P. connected to the gearing. Tickets are printed at the rate of 2 per second.

The rotary press carries six stereos each with its separate dater and recorder. Pressing one of six keys imparts a rotary movement to the cylinder which prints

(1) *Ticket Issuing Machines Ltd.*, London.

certain particulars on blank ticket material propelled through the action of a cam. Still rotating, the cylinder engages with further fixed cams which press the partly printed ticket first against the numerator, next again the dater. At the same time, the cell's recorder which is of the cyclometer type, is geared in and records the number of tickets of each de-

tally with the sum of the partial results of the six cells.

The feed mechanism allows material of any thickness from thin paper to thick railway ticket 0.03" card to be used, but will not work when unprovided with any material.

An ordinary separately enclosed letterpress ink can be easily taken out for cleaning.

I. The S. P. Self Printing Ticket Issuing Machine of the *Bell Punch Co. Ltd.*, is an electrically driven, key-operated rotary ticket machine, particularly suited

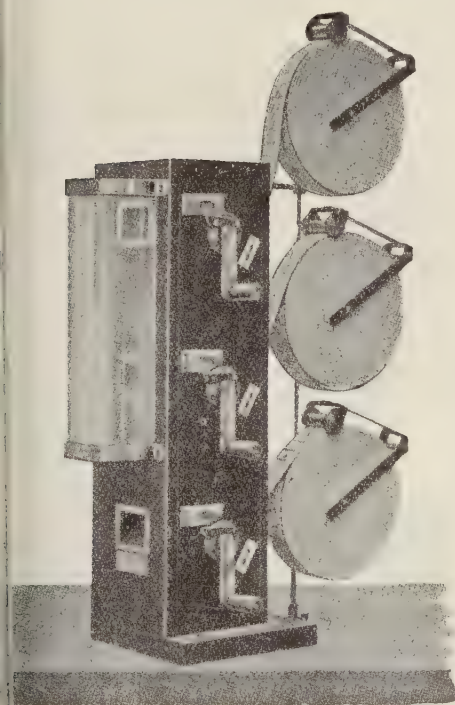
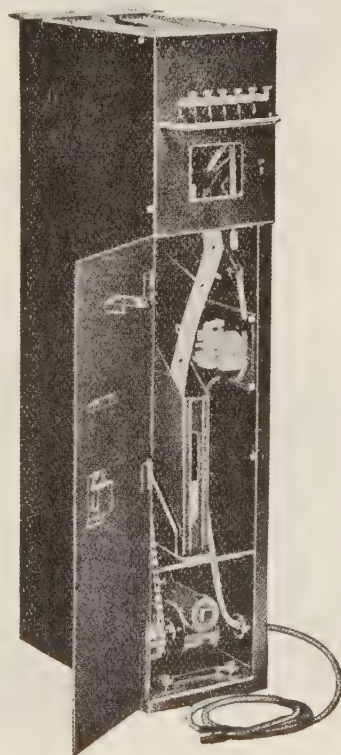


Fig. 711. — *Rolttie* three-way hand-operated machine issuing three sorts of pre-printed tickets.

Size : 6" by 6"; overall width : 14 1/2"; height : 26".

mination that have been printed (fig. 711).

A totalising meter aggregates the total of all tickets sold and its results must

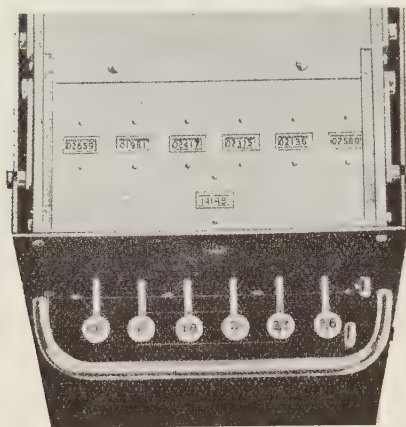


Bell Punch Co.'s « *Printix* » ticket printing and issuing machine.

Fig. 712. — View of mechanism, paper strip and guide bars, with door open.

to railway ticket offices where limited ranges of different tickets are required.

The machine is designed to become an



Bell Punch Co.'s « Printix » ticket printing and issuing machine.

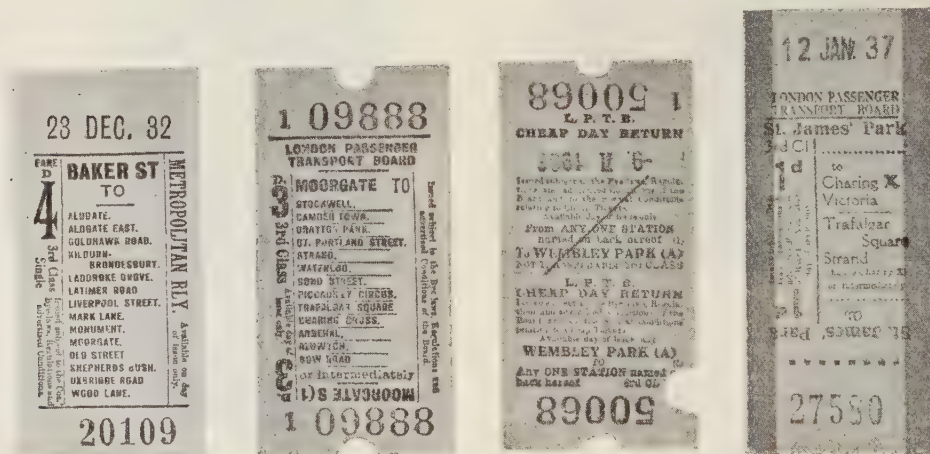
Fig. 713. — Top of machine without cover plate — Six indicator windows for six counters — A seventh gives the reading of the totaliser — Fares for multiple-destination tickets shown on keys.

integral part with the ticket office counter, its top-plate of stainless steel forming the counter top. It is available in five sizes, to issue from two to six different tickets, and in view of the fact that each ticket is printed on its own individual material, the machine takes up very little room.

All machines are 2' 5" high and 14 1/2" deep, and their width varies according to the number of ticket passages required, for example, a 2-way machine is 10" wide, a 3 or 4-way 15 1/2" wide and a 5 and 6-way, 21" in width.

The machines are very fast in operation, each printing unit having three operating keys to produce one, two or three similar tickets at one depression of a key.

Mechanical arrangement is on the unit principle; each ticket printing, issuing and recording mechanism is a standardised, self-contained unit (figs. 718, 719).

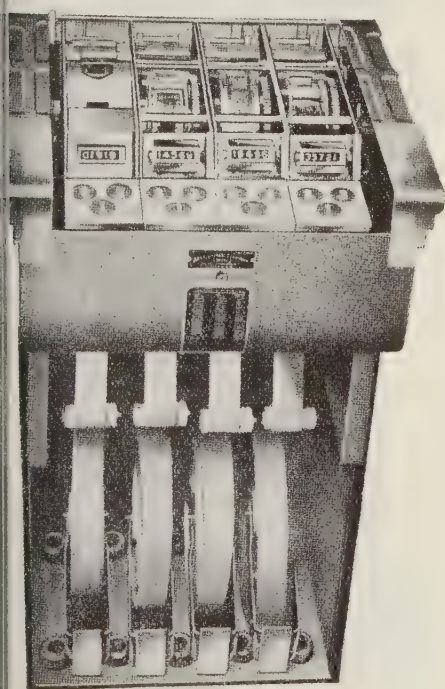
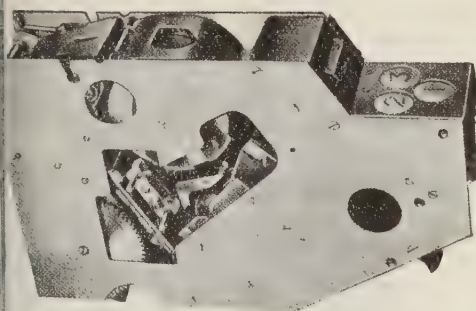


Scheme tickets, London Underground. (Red. 4/5).

Fig. 714. — Tickets from « Printix » issuing machines.

Figs. 715, 716. — Single and return tickets from « Rolltic » printing and issuing machines.

Fig. 717. — Tickets from « S. P. » printing and issuing machines.



figs. 718, 719. — « S. P. » (self-printing) machine, Bell Punch Co., London.

Fig. 718, side view of one of the printing units. Fig. 719, printing machine with four units — the individual covers have been removed in all units but the left-hand side one.

These units drop into position in the chassis with one transmission shaft to

operate all the printing units. The whole mechanism is encased in metal.

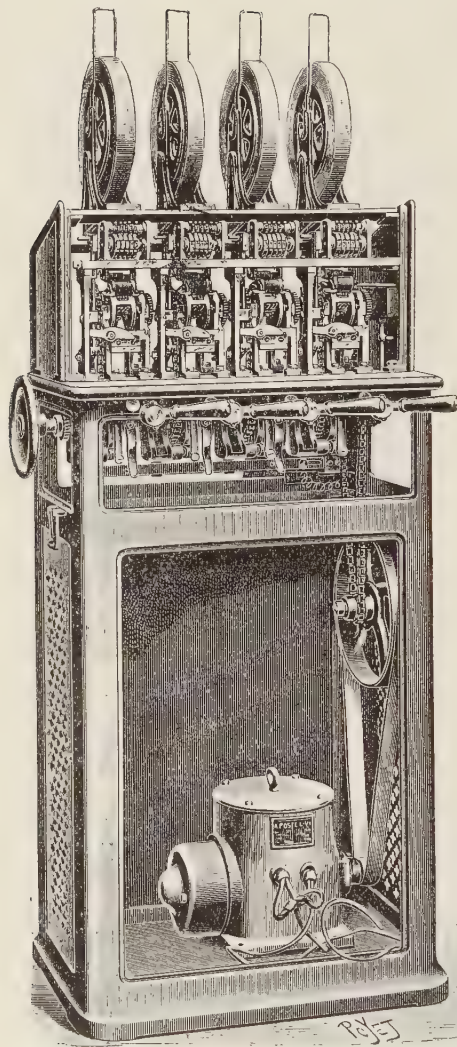
Any unit requiring attention can thus be removed and replaced in a few seconds, and by mounting beforehand printing plates for tickets outside the usual range, the substitution of a unit so prepared enables the machine to issue these tickets the moment it becomes advisable to do so.

The S. P. UNIT is a rotary printer embodying a printing drum to which the ticket number and date printers are fitted, and on which the printing plate, termed the stereo, is clamped. Other members of the unit are the issue and recording mechanisms, the knife mechanism and the inker. All these are readily accessible and are directly driven by gear or cam and lever.

Recorders are of the continuous, cyclical type, irreversible, directly driven. They are encased to be inaccessible, but at all times visible to the operator.

Access to the mechanism is a matter of moments only.

TICKETS. — An exceptional characteristic resides in the fact that tickets issued by the S. P. machine differ not only in colour and in printed particulars, but also in length (fig. 717). The same machine can produce from one to five-inch long tickets, the length of the ticket being automatically controlled by the length of the printing plate, termed the stereo. No adjustment of the mechanism is needed to alter the length of the tickets. Their standard width is $1 \frac{3}{16}$ ", but machines can be specially made to produce tickets 1" to 2" in width. They can be printed with either a serial number and date or numbered at each end. By simple adjustment of pressure of a roller in the mechanism, the machine prints on any



Open.



Closed.

Figs. 720, 721. — No. 5 « M. N. S. » machine, « *Metropolitain* » 1907 type, made by the *Appareil Contrôleur* Works, Paris.

material from thin paper up to ticket card, a distinct advantage where a regular supply of standard ticket material is not a certainty.

J. The 1900 model of « *Contrôleur chine* », was made by the *Appareil Contrôleur Co.*, of Paris, for use on the *tropolitan Ry.* (Number 1 line), wh

opened in time for the Paris Exhibition. Its main features are those previously embodied in the maker's multi-printers, altered and simplified to suit urban railway with a fixed fare for each class whatever the distance travelled.

There is thus no need to print the name of destination stations on the tickets.

All particulars save the date and serial number are constant. There are separate serial numbers for the various categories of tickets :

- single;
- double;
- and returns;
- emergency tickets (marked « S »).

Date and time of issue are shown by numbers of 6 figures printed on a single strip in three groups (figs. 268, 723) :

- figures showing the number of the day of the 365 or 366 of each year;
- figure showing the unit of the year;
- figures stating the hour from 01 to 24.

The same idea has been applied by a similar number of other Companies.

It will be remembered that in the *Contrôleur* multi-printer the tickets are printed by two composing units, a fixed one for the constant particulars and a set of mobile ones placed behind an upper drum, for printing the variable part of the ticket with its variable elements : the name and number of the destination station, and the corresponding fare. The *Metropolitan Ry.* fares are constant whatever the destination, and the latter's name and number are needless. A single printing unit can therefore do the work formerly devolved upon several hundreds of similar ones.

The actual printing is still done by two units, printing separately on the upper and lower parts of the tickets. The first unit prints the particulars that do not

vary from one ticket to another, besides printing the date and time of issue by multi-disc daters with type figures ranging from 0 to 9.

The second unit prints the serial number, which increases by one as each ticket is printed, and carries the stereo for printing the lower half of the ticket.

There is a totalising counter attachment in the upper part of the machine, which records the number of tickets issued.

Each machine is really a quadruple one, there being 4 separate printing units each of which can issue 100 tickets a minute. The carton rolls have a capacity of 2,000 tickets.

The mechanism is put in motion by depressing a lever. This causes the printing table to rise and the inker to recede and ink the composing unit while an arm forces the units wheel of the composing unit and the totaliser a step further. The table then presses the strip of carton against the composing unit and at the end of its upward stroke, it causes the cutter to open.

The ticket is then printed. The table descends and on the way, causes the drum to make a third of a revolution which obliges the strip of carton to advance by the length of a ticket. The table brings the inker back into its original position, inking the composing unit once again on the way, and when finishing its descent forces the cutter to close on the ticket strip which it severs. The ticket then falls through an opening in the machine.

K. The 1907 model of « *Contrôleur Machine* » for the Paris *Metropolitan Ry.* was made by the same builders for Line n° 2. It brought a number of improvements to the previous machine whose reciprocating mechanism was far too noisy.

Like in the 1900 type, there are four identical printing mechanisms to issue four categories of tickets.

The newer machine (figs. 720 and 721) is provided with a rotary printer.

Between the flanges of the upper drum is a double composing unit stretching along part only of its circumference, say about one fifth; this double composing unit prints the two portions of the tickets in the usual way. Each bears fixed particulars for direct printing and printing discs for the variable data. Those of the first unit (moment of issue), are changed by hand; those of the second unit (serial number), change automatically.

The electric motor is put in motion by depressing an operating handle and this starts the main shaft that unlocks the mechanism and operates the clutch. By means of a chain, the shaft rotates the printing drum which in turn drives the feed cylinder. At the same time, a rod opens a cutter as it descends, and the strip of carton advances whilst the composing units print. In addition, when descending, the rod causes the lever that has moved the totaliser one unit, to descend.

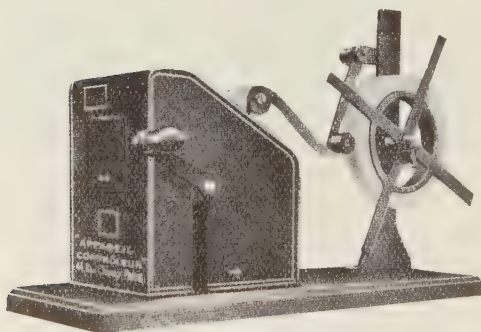


Fig. 722. — No. 14 « M. A. M. » machine. Paris Métropolitain Ry., for printing and issuing one kind of ticket only; made by the « Appareil Contrôleur » Works.

The printed ticket remains stationary whilst the printing drum finishes its movement. The carton strip being held by the rod is driven upwards during the second half of the revolution and clamped by the cutter, thereby severing the completed ticket from the strip of carton. The ticket has projected from the machine, while the cylinder revolved.

All this time, a lock has held the clutch sleeve engaged. A check spring causes it to fall into its notch which disconnects the mechanism and opens the circuit while the check spring obliges the rod to return to its original position.

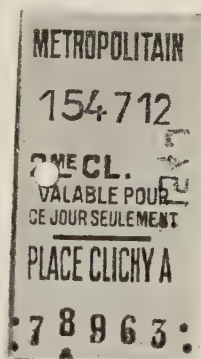
Emergency tickets similar to the usual ones are used when any printing element is out of order. Each station also has a reserve stock pre-printed on carton, whose colour differs slightly from the standard, so that they should be easy to distinguish from them.

Since they were introduced, a number of other improvements have been brought to these machines, many of which are still manufactured by the same maker.

Kb. The machines of the « Forchambon Works » are very similar. The latest of them print seven kinds of tickets which they issue singly or up to five at a time (fig. 724).

The ticket, cut to length, is grasped by the printing mechanism and printed with the usual constant and variable particulars. It is then thrown into a hopper whence a transporter band carries it to the passenger. Printing the ticket, numbering it, and recording it on the counters cannot be done separately.

The machine has neither spring nor pawl, all movements are positive, and counters cannot be tampered with. Printing is rotary, the wear, if any, is negligible. The inker works three months before there is any need of refilling.



Present-day semi-blank tickets of the Paris *Métropolitain Ry.*, printed and issued by machines. (Red. 4/5).

Fig. 723. — Issued by « Appareil Contrôleur » machine.

Fig. 724. — Issued by *Chambon* machine.

Two rows of keys, easy of access, operate the machine. The upper one controls the category, the lower, the number of

identical tickets that are to be issued together. Interlocking prevents pressing down two keys of the same row simultaneously.

The machine is normally set to issue the type of ticket that is most in demand, so that it is unnecessary to depress any of the « category » keys for the purpose; a single key of the lower row concerning the number of tickets is alone depressed.

The printer only rotates when issuing a ticket; it is set in motion instantaneously when a lower row key is pressed down.

The machine does not work should the strip of carton break or give out. It takes but a few seconds to start another, and the first ticket printed is fit for use.

L. The A. E. G. « Rapid Printer » has a number of motor operated printing cells whose number varies according to needs (figs. 725 and 728). The overall

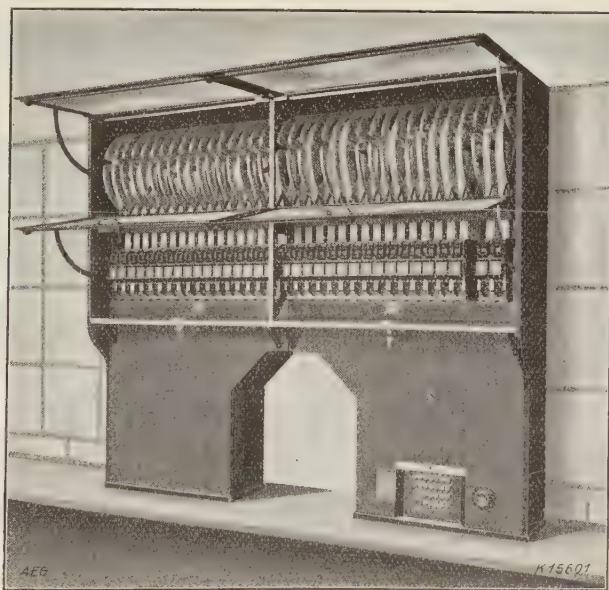


Fig. 725. — General arrangement of A. E. G. « Rapid » printer, booking office window type.

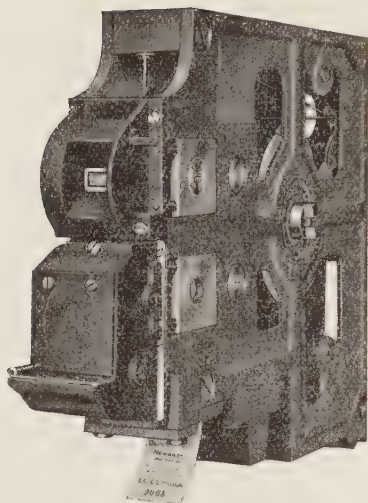
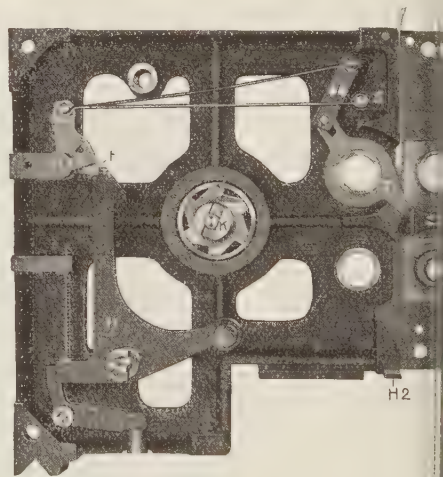
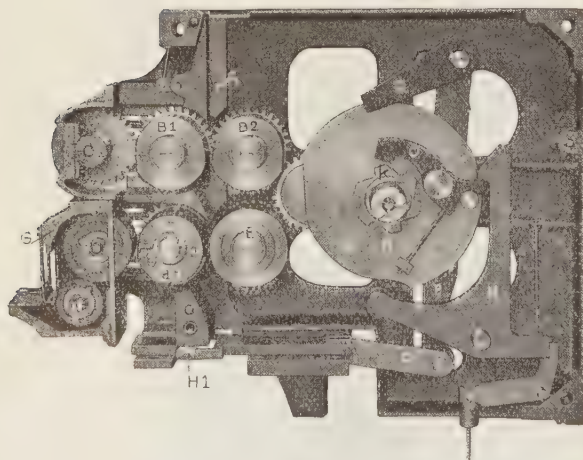


Fig. 726. — External view of unit containing printing and control mechanisms. A. E. G. « Rapid Printer », booking-office window type.

length of a ten-way machine is 3', of a 15-way, 3' 10", of a 20-way, 4' 6", of a 25-way, 5' 3". Others exist for printing more tickets still : 30 and even 35. All of them are 3' 11" high and 1' 5 1/2" deep.

These machines print a constant text and fare, they date the tickets, number them serially, cut them to size and record the issues practically in one operation, so rapid is their action. They are as safe in working as the A. E. G. multi-printers.

The machine is operated by a keyboard whose keys resemble those of a typewriter, and bear on their face the name of the category of ticket they issue. Depressing a key sets a small printing unit for operation. The connection between the key and the unit is by Bowden wire. By the same movement of the key, the main 1/5-B. H. P. motor is energised and the-



A. E. G. « Rapid Printer ». booking-office window type.
Fig. 727. — Printing unit, showing slightly simplified mechanism.

- A — Locking device.
- B1, B2 — Driving rollers.
- C — Direct reading counter.
- D — Plate carrying roller, containing serial numbering device.

- E — Printing roller.
- f1 — Catch moving in groove f2.
- G — Inker.
- H1, H2 — Movable and fixed cutters.

reby the printing unit is set in motion as is also the conveyor belt which discharges the ticket onto the counter. By maintaining the key depressed, and thereby the machine continuously in motion, as many as 200 tickets may be issued per minute by a 20-way ticket machine. After the key is released, the driving motor allows sufficient time for the operation to be completed before being arrested.

Each cell is a complete unit. It contains a printing and a control mechanism comprising :

- (a) The print block, the numerator, and the dater;
- (b) The counter, the cutter, and the safety devices.

Four rollers rule its actions. Rollers B_1 and B_2 are contained and geared together in one exchangeable print block. To roller B_1 is fitted a printing plate containing all the matter that is printed on the ticket with the exception of the date, which is fixed on the first of these rollers which also contains a numerator for numbering the tickets serially. The stud f_1 which engages with groove f_2 makes the counter advance one unit each time printing takes place. The second roller is actually a kind of ground pad for supporting the ticket strip during the printing process.

The other rollers, B_3 and B_4 , are connected through a series of gears to the main driving shaft and act as transport

rollers. Together, by means of knurled flanges on both of them, they draw the ticket strip from the carton drum through the printing process and push it through the open guillotine to the re-

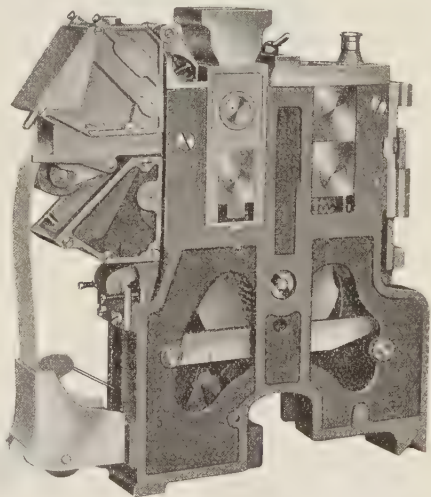
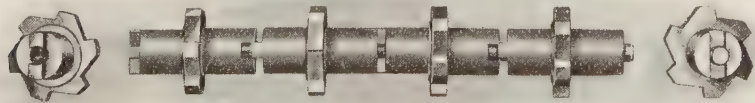


Fig. 728. — Desk type printing unit of A.E.G. « Rapid Printer ».

quired length of the ticket. During this process which represents one revolution of the rollers, Roller B_3 , to which is fitted a dating device, imprints the date on the ticket and thus finishes all the printing.

The guillotine is operated by means of a cam which is suitably geared to lift the lower knife to shear the ticket at its re-



A. E. G. « Rapid Printer ».
Fig. 729. — Spindle of printing unit, with mortice- and tenon joints.

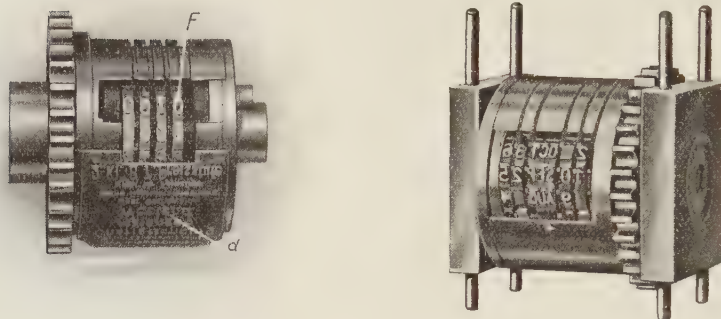


Fig. 730. — Type discs — A. E. G. « Rapid Printer ».

quired length, after which it is dropped on the conveyor belt.

If the ticket is to be dated above and below, a double dater is used.

As it leaves the rollers, the strip meets two cutters, one moveable, H_1 , the other fixed, H_2 . The guillotine is operated by means of a cam suitably geared to lift the lower knife to shear the ticket at its required length, after which it is dropped on the conveyor belt. This is how things work.

The rod connected to the key acts on the right arm of a crank of the control pawl L which in turn frees crank M . A spring turns the latter until the roller at the end of its left hand arm comes in contact with cam N . Its other arm then frees the curved pawl O , the head of which engages with one of the notches of the actuating wheel K , which is fixed on the spindle and turns with it. The cam N then follows the movement of the spindle.

After one revolution, automatic declutching occurs, because the cam N returns to its original position and the pawl O withdraws from the wheel. If the crank M does not return to normal, the movement starts again and repeat printings take place. The spindle at the end of lever p , forced into a recess on cam N ,

prevents any backwards movement of the mechanism. There are also various safety attachments.

The entire printing unit can be easily removed from the machine, the lock being effected in a crescent shaped recess at the bottom of the unit. This is the reason the cells are not connected by one long shaft and each has its own, with mortice and tenon instead.

The PRINT BLOCK is cylindrical and 6" long by 1 3/4" by 1 3/4". The upper face shows the booking clerk a summary of the particulars it prints, such as

Category;
Destination;
Fare;
Number of the block;
Ticket counter.

It is interchangeable so that different tickets may be issued at different periods. The block can be withdrawn from the printing unit even without removing the latter from the machine. As the gears become automatically locked while doing so, the counters are not affected.

The INKING ROLLER G is formed of a metal and a felt drum, g_1 and g_2 , and is behind roller B_1 so as just to come into

act with it and ink the printing plate
revolves. One soaking of the roller
effectively ink the plate for the spa-
of 15,000 tickets. Should back print-
be desired, a second inker is added
the fourth roller B_4 , opposite the print-
one.

Each printing unit is fed from its own
circular CARTON STRIP contained in a
whose fixed spindle support is so
igned as to allow it to revolve with a
imum effort. When full, it contains
cient carton for printing 1,800 to
0 tickets according to the thickness
ne strip. In the event of the strip
ing out, a positive trip which is at-
ed to the first ticket strip guide,
s into a slot by gravity operation and
matically throws out the printing me-
ism, thereby preventing the counter
ne print block from making a false
ter.

the drum's TOTALISOR counts from 0
9,999 and the counters, from 0 up
9,999. These latter become visible to
clerk only when the top of the ma-
e is opened up.

the TICKETS are dated, cut off and
oped on the conveyor belt and in-
ly ejected in front of the passenger.
ng this time, the ticket issued is au-
tically recorded on the counter, a
d ticket is printed but not dated and
rd, placed in position for printing.
sion is made, by means of an inter-
of the operating keys, that only one
ing unit can be operated at a time.

ECIAL UNITS have been designed ac-
g to requirements, in particular
with a third set of rollers for print-
ne number of the month or week on
ly or weekly commutation cards;
s are used as automatic printing
g machines (fig. 731).

CHAPTER XXI.

AUTOMATIC MACHINES.

Various types of machines have been
used for a number of years, usually for
printing one kind of ticket only or at
most, a few different kinds for heavy ur-
ban or suburban services.

After slipping a coin into a machine of
the older kind, a push lever was depressed
which caused the ticket to be printed and
cut to size; it then fell into a tray where
the passenger collected it.

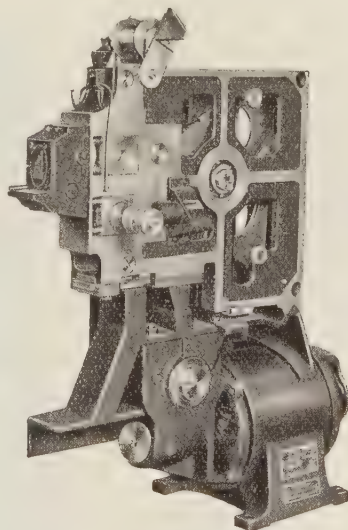


Fig. 731. — A. E. G. Automatic machine
printing unit.

Improvements have been made since;
clockwork mechanism prints the tickets,
cuts them off a reel of carton and issues
them to the passenger; the printing is
usually poor, sometimes quite defective.
Modern electrically-driven machines are
free from these drawbacks.

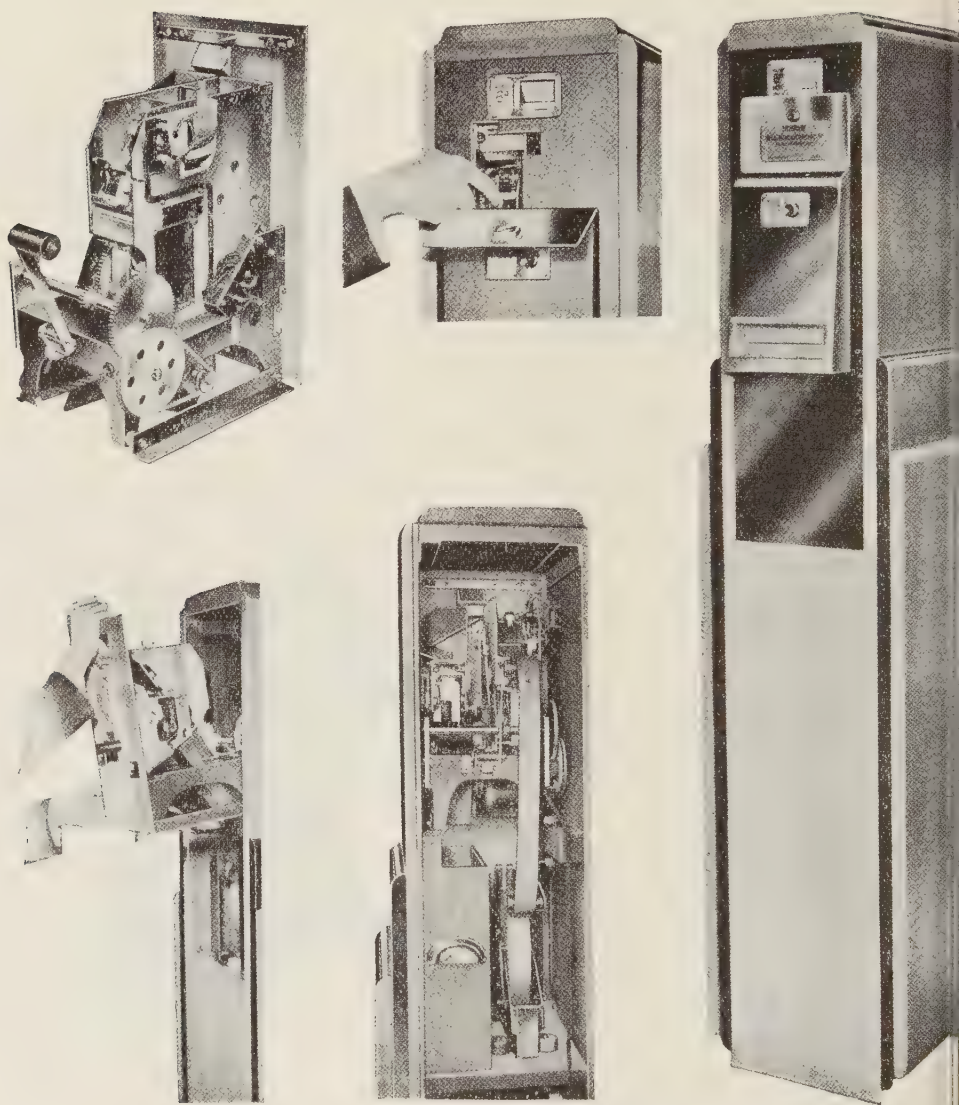


Fig. 732. — « S. P. A. » (self-printing autoslot) machine,
made by the *Bell Punch Co.*, London.

Above, on left : rear view of printing unit; height, $16\frac{1}{2}$ " ; width, $8\frac{1}{2}$ " ; depth, 13".
Beneath, on left : insertion of a unit into the machine.

In centre, above : adjustment of data.

In centre, below : rear view of machine, showing in upper part an « S. P. A. », unit and the cash box, and the roll of thin carton.

On the right : general view of machine in its case, which may be of wood or metal.
Height : $5' 6''$.

M. The Hall automatic ticket printing and issuing machine is made by *Hall Telephone Accessories (1928) Ltd.*, London. It prints tickets from standard paper rolls having a capacity of approximately 1,000 tickets, 3" in length. Should the paper supply become exhausted or should the roll break, the machine is « closed » automatically.

Coin or coins put the machine in motion. The tickets are serially numbered at one end, dated at the other and printed on one or both sides to the customer's requirements by one or two printing drums.

The machine has a spurious coin detector. The mechanism is operated by a small motor which consumes the same current as an ordinary 40-watt lamp. The machine is housed in strong metal cases and weighs 33 lb. without and 350, with the case. When two mechanisms are used side by side, the respective weights are 70 and 470 lb.

The mechanism operates as follows :

When a coin is inserted, it passes through the detector and reaches a balance arm which descends under its weight and transfers the money from the hopper to the coin tubes, at the same time operating contacts. These close a circuit which releases the clutch mechanism which couples up a toothed wheel geared to the motor and the printing drums so they can operate together. As soon as they rotate, the contact lever with its projecting pin engages with the periphery of a flange on the printing drum and is raised, closing another set of contacts. The former contacts being released, return to their normal position.

After one complete revolution of the printing drums, a contact lever falls into its notch, breaking the motor circuit through the second set of contacts and at the same time the clutch mechanism is disengaged. The guil-

lotine blade operates on the final movements of the drum lever and ensures the return of the balance arm to its normal position.

Before the machine is ready for public issuing of tickets, the lever should be pressed twice for two revolutions of the drums. The first revolution produces a blank ticket and the second revolution produces a half-printed one, after which the machine is ready for use.

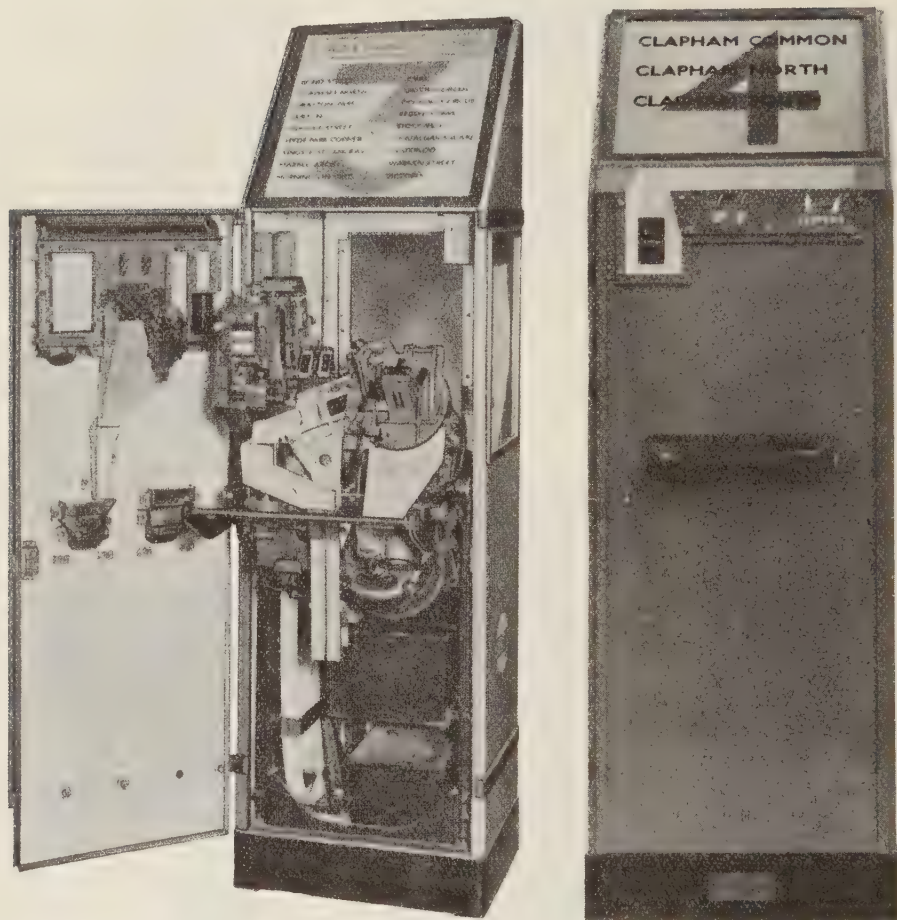
The DATING DEVICE consists of three ten-digit wheels or two ten-digit wheels and one « month » wheel and a « year » wheel, and should be set in the first case to the number of the day in the year as 001 for Jan. 1st., or 365, for Dec. 31st. and in the second, to 1 Jan. 34 or 31 Dec. 34. These wheels are easily turned by a small fibre pencil.

The NUMBERING DEVICE is on the lower printing drum and may be brought into view by turning the drum by hand so as to set the numbering device to zero when necessary.

The INKING APPARATUS consists in a carriage or framework supporting two felt rollers held in contact with one another by a spring. The rear roller hub contains the ink supply and is provided with a knurled screwed cap. This tubular receptacle has a number of small holes in the side through which the ink oozes and keeps the felt fully charged. The forward roller receives the ink from the rear one by contact trough rotation. One charge of ink is sufficient for two weeks under normal conditions.

In order that it may have time to dry on the tickets, there is always one pre-printed ticket in the machine.

N. The A. E. G. Automatic machine



Figs. 733, 734.

Brecknell, Munro and Rogers ticket printing, issuing and change-giving machines. Two types, for scheme tickets.

has a printing unit on the lines of those used in the *A. E. G.* « Rapid Printing » machines. The guide rollers are placed above the printing units, the meter being actuated by the right-hand guide roller and the other roller serving as a dater (fig. 731).

O. The « *S. P. A.* » (self-printing autslot) machine (fig. 732) is also manu-

factured by *Bell Punch Co.* and is in use on many electric and local railways, for platform tickets, etc.

It is an automatic coin-operated ticket printer and issuer, very similar to the *S. P.* in its main and mechanical features; the ticket feed, the printing, issuing and recording mechanisms are identical. It is of unit-construction but, unlike the

P., the motor and transmission are integral parts of the removable unit. This enables all the mechanism to be removed for storage, an advantage when the machine is located in exposed situations and is employed during a part of the year.

The casing is designed to suit requirements and to hold the units singly or grouped together. The machine is made to operate with one or more coins, in any station where electric current is available, and is often used to assist a ticket collector when the work is exceptionally heavy or even to continue sales when the ticket machine is closed.

The COIN-SELECTION MECHANISM is straightforward, the recording infallible, being directly gear-driven from the printing mechanism.

The coin-operated actuating mechanism is at the left of the printing unit. The coins travel down a zigzag chute and into a balanced coin selector. If they are under size or weight, they fall into a trough on the front of the machine, which is also the delivery location of the printed tickets. A coin which is oversize remains in the coin-selector until the button is pressed; it then returns to the trough.

Coins are returned in the same manner when the ticket material is exhausted. In neither case, of course, does the machine record an issue.

When a coin is accepted, it tips the balanced selector and two pairs of electrical contacts are closed. The motor is then into circuit with the electrical current and the printing mechanism is mechanically connected with the drive. A ticket is then printed, recorded and issued. The whole operation taking but a moment of time.

The coin is released to pass into the coin box, the electrical contacts are again opened and the drive between motor and printing mechanism is again disconnected. The printing mechanism is then gently arrested and the motor slows to rest.

The disconnection of the actuating mechanism from the printing mechanism when the ticket feed is exhausted is by means of a paper lock which falls and opens a pair of contacts in the electrical circuit. No movement of the mechanisms can take place until the ticket feed has been renewed.

TICKETS. — As with the *S. P.* machine, the *S. P. A.* produces tickets serially numbered and dated or, if preferred, doubly serially numbered, once at each end of the ticket, on any material and of any length from 1 inch to 5 inches.

An advantage of both the *S. P.* and *S. P. A.* machines is that they can turn out tickets any material that is available: this enables them to accommodate themselves to unforeseen future requirements.

The appearance of the tickets can be changed at will by substitution of one ticket printing material for another. Also requisite stereos can be produced from a blockmaker at a few hours' notice at a cost of a few shillings.

The quantity of tickets obtainable from a reel depends on the material — the thinner the material, the greater its length in the reel. Thus 1,400 tickets 3" long are obtainable from one reel of ticket material of 8" diam. and 0.012" caliper.

P. A. Brecknell, Munro and Rogers ticket and change-giving machines are each made so as to print and deliver one kind of ticket, and to return the change, when necessary (figs. 733, 734).

A large number of these machines are in use on the London Underground railways. They are electrically operated and driven by a 1/5-H.P. motor which is provided for any current supply.

They are mounted in a sheet-metal case or in any other which conforms with the general decorative scheme of the premises. Access to the mechanism is obtained either through the back or the front of the case; the entire mechanism can then be pulled out on a specially provided truck.

The newer machines are 1' 8" wide, 14 1/4" deep and 4' 11" high.

There are three types of change-giving machines according to the price of tickets issued: 1 d. to 3 d.; 6 d. and 1 sh.; 7 d. to 11 d., and two types of machines without change-giving: 1 d. to 5 d. and 6 d. to 1 sh.

The COIN-MECHANISM which operates the printer is again of unit construction.

For machines selling tickets up to 3 d. in value, change-giving facilities are usually provided for the insertion either of coppers (in any combination) or a 6-d. or a 1-sh. piece; in the latter two cases, the appropriate change are issued simultaneously with the ticket. On machines issuing tickets of a value over 6 d., i. e., 7 d. to 11 d. inclusive, the ticket can be obtained by inserting either a 6-d. piece and the necessary coppers, or a 1-sh. piece or a 2-sh. piece, the appropriate change also being given. For a 6-d. ticket, change is given for 1-sh. or 2-sh. pieces. The addition of change-giving facilities does not slow up the operation of the machine.

Either pennies or halfpennies or both can operate it. The coins can be put into the machine in a bunch or in a hap-

azard manner; the total amount for several tickets may even be inserted simultaneously. And coins for the next ticket purchasing passenger may be inserted



Figs. 735 to 737. — Tickets from *Brechun* and *Rogers* printing and issuing machines. (Red. 4/5) — London underground railways.

even before the machine has delivered ticket or tickets to the previous one. enables as many as thirty tickets to be delivered per minute, with change for each case.

Three slots are provided on the primary change-giving machine. The coin insertion point can hardly be described

a slot because it is, in fact, a round aperture slightly in excess of the diameter of a penny. It is therefore very easy to pour into this aperture a comparatively large number of pennies and/or half pennies simultaneously. The other two slots are for 6-d. and 1-sh. pieces (and 1-sh. slot on the 6-d. and 1-sh. machines). In the case of 6-d. and 1-sh. machines, the copper slot is, of course, omitted.

After insertion into these slots, the coins are tested and counted and immediately afterwards, they switch on the meter mechanism and also if change is to be given, the change-delivery mechanism.

Coppers and silver are automatically delivered in the change-giving machine's meters.

The PRINTER is of purely rotary type. The number of printing rolls in the meter naturally depends upon how much printing is required on the ticket, whether it is on one or both sides of the ticket. Should it be desired to print different tickets at different times each day, the actual printing rolls can be removed from the printer in a matter of seconds and a different pair of rolls substituted, these rolls being mounted in a printer box which is simply dropped into suitable guides in the printer unit.

In the top of each printer box is provided a COUNTER which records the number of tickets issued by that printer and this counter cannot be altered when the printer box is out of the unit, but only by completely dismantling it.

TICKETS (figs. 735 to 737). — The machine prints its own tickets from a plain or thick paper. The printing can be made out on one or both sides of the

ticket, and both dating and a serial number can be included. A blank roll of ticket paper is of sufficient size to give between 2 000 and 4 000 tickets, depending on their length. Usual ticket lengths vary between 1 3/4" and 3".

Each roll is mounted in a clip fixed at the base of the machine and designed for the almost instantaneous removal of an old roll and the substitution of a new one. The paper passes from the roll through the printing unit and provision is made so that if the paper ever runs out or breaks, the machine automatically switches off and any coins thereafter inserted into the machine are returned.

Machines for printing and issuing paper tickets.

CHAPTER XXII.

These self-printing and issuing machines print tickets as required, off rolls of blank paper with which they are provided. These rolls allow the issue of up to several thousands of tickets of a number of denominations and a number of categories. At the same time, the number of tickets issued and their total value is recorded on special registers and the machines, which are relatively light, are so constructed that the conductor is unable to tamper with them. Each is, besides, provided with a number of safety devices.

Some types can, at will, be fixed to the car or mounted in a booking office.

The following table lists those that are described hereafter, together with the size of the tickets, the ticket-capacity of the paper rolls and the weight of the machines.

MACHINES.		Size of tickets.	Capacity of the rolls.	Weight of the machine lb.
PORTABLE.				
Q	« T. I. M. »	3 1/4" × 1 1/2"	200	3 1/2
—	« T. I. M., major »	4" × 1 1/2"	170	4
R	« Verometer »	3 1/2" or 7 1/2 × 1 1/2"	1 000	5 1/4
S	« Autowaybill »	2 3/4" × 1 1/2"	600/1000	3 1/2
T	« Westinghouse »	2 3/4" × 2 1/4"	300	5 or 4
FIXED.				
U	Olmer	3 1/2" × 1 3/4"	2 500	30 or 2

Q. The standard T. I. M. (ticket issuing machine) (fig. 738) is a compact portable machine, a complete system within itself, weighing not more than 3 1/2 lb. The case of the machine is made throughout of duralumin and is strong, light and dust-proof. It prints and issues a ticket 3 1/4" by 1 1/2" (fig. 740), from a roll of plain paper, contained in a magazine, which is quite apart from the mechanism of the machine.

The machine is a rotary printer, the steel mainshaft being carried in two ball-bearings and so obviating the wear inevitably caused by reciprocating parts.

The inking of the printing dies is from specially constructed rollers to which the special quick-drying ink is easily applied with a small brush or with an automatic inking machine.

The meters or counters are of steel. They are not liable to wear, the usual cause of unreliability in die-cast counters.

The printing plate is also made of steel, which in addition to giving clearness of type, is not liable to wear.

Each roll contains approximately 100 tickets and has a safety device which warns the conductor of the approach of the end of the roll; inserting a new one takes not more than ten seconds.

These rolls have a specially prepared absorbent, quick-drying surface. The characters are boldly printed, and as large as is compatible with the size of the ticket.

The following data are provided :

Fare paid;
Category of ticket;
Stage boarded;
Service or route number;
Date;
Serial number;
Number of issuing machine;
Name of the Undertaking;
Conditions of issue.

Any nine fare values are provided, by means of a special combination in which double value tickets can be issued, constituting so called « married » tickets with both values on one trip.

Any categories ⁽¹⁾ of tickets are

(1) We have substituted « category » to the more usual appellation « class », the latter also applying to different classes of travel, when the Company caters for them.

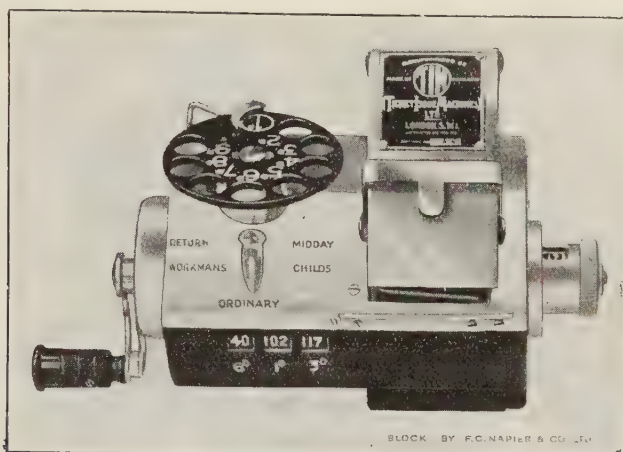


Fig. 738. — « T. I. M. », printing, issuing and recording machine.

vided, such as ordinary, workman's, child, mid-day, return, etc.

STAGE BOARDED. — One hundred stages, from 00 to 99, are provided and are alt-

ered by hand as each stage point is reached; clearly visible indicator wheels confirm the stage at which the machine is set.

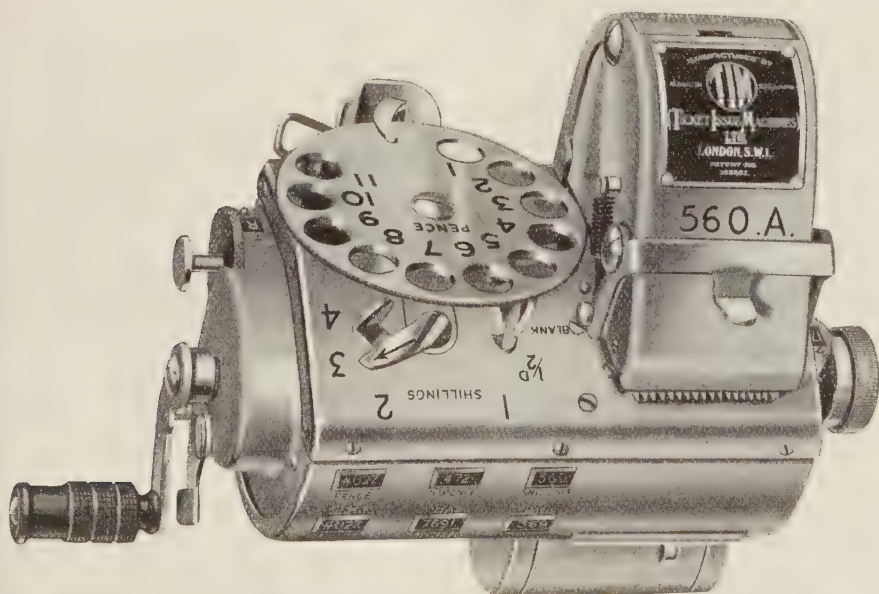


Fig. 739. — « T. I. M. » Major machine with new class mechanism (category), and increased fare range.

DATE AND ROUTE NUMBER. — These items of information are provided for and are easily altered by the ticket office staff or, if necessary, on route.

RECORDS. — Each of the nine fares provided on the dial is recorded on its own individual meter and there is, in addition, a totaliser-meter, which gives the total number of tickets issued.

This record, by an ingenious independently operated mechanical arrangement, corresponds to the serial number printed on the ticket, thus providing, in conjunction with the date, not only an infallible check on the validity of the ticket, but also two cross checks on the cash receipts. There is, further, a separate meter, which records all the tickets of any one particular category. This, as a rule, is used for recording the « return » tickets, although two categories of tickets, such as « ordinary return » and « workman's return » may be jointly registered if a composite « return » total is required.

The **T. I. M. CANCELLER** does away with the exchange ticket, which is issued in exchange for the return portion of a return ticket, whilst preventing the use of a dead return ticket.

It mutilates the ticket and, at the same time, imprints a serial number and identification. This number is recorded on a meter, which also bears the same identification as the imprint.

It is virtually impossible to use the ticket again, as the serial number is synchronised with that on the meter and can be easily identified.

The cancellation punch, which is attached to the harness, is 1 5/8" by 1 3/8" by 1/2" and weighs about one lb.

The case of the **T. I. M. Cancellor** is

made of duralumin, the recording meter and mechanism, of steel.

Qb. The T. I. M. « Major Machine » (fig. 739) has a larger RANGE OF FARES, which provide for 71 individual values instead of 9, ranging from 1/2 d. to 4 sh. 11 d.; thus the ticket can be printed with 1/2 d. value and halfpenny rises up to 11 1/2 d. and thereafter in penny rises up to 4 sh. 11 d.

ISSUED SUBJECT TO THE REGULATIONS OF THE CHINA GENERAL OMNIBUS CO. LTD.	STAGE	1361		車費 8 已付	
	23				
	ROUTE	09A	DATE		26JU35
	ENTERED	09A	26JU35		

Fig. 740. — Paper ticket from « T. I. M. » machine. (Red. 3/4) — *China General Omnibus Co., Ltd.*

This does away with the « married » ticket; the totaliser meter which in all models shows the number of tickets issued, therefore also shows the number of passengers carried.

RECORDS. — On account of the wider range of fares, the separate fare records have obviously had to be abandoned and instead of the individual statistics provided on the standard model, there is now a cash record in units. Thus there is a unit meter for halfpence, pence and shillings respectively, and as a check on these, there are duplicating meters for pence and shillings. This is probably the only machine with a double check on the cash records, within the machine itself.

The **TICKET** being of increased length, the rolls contain fewer of them, the number being approximately 168 to 170.

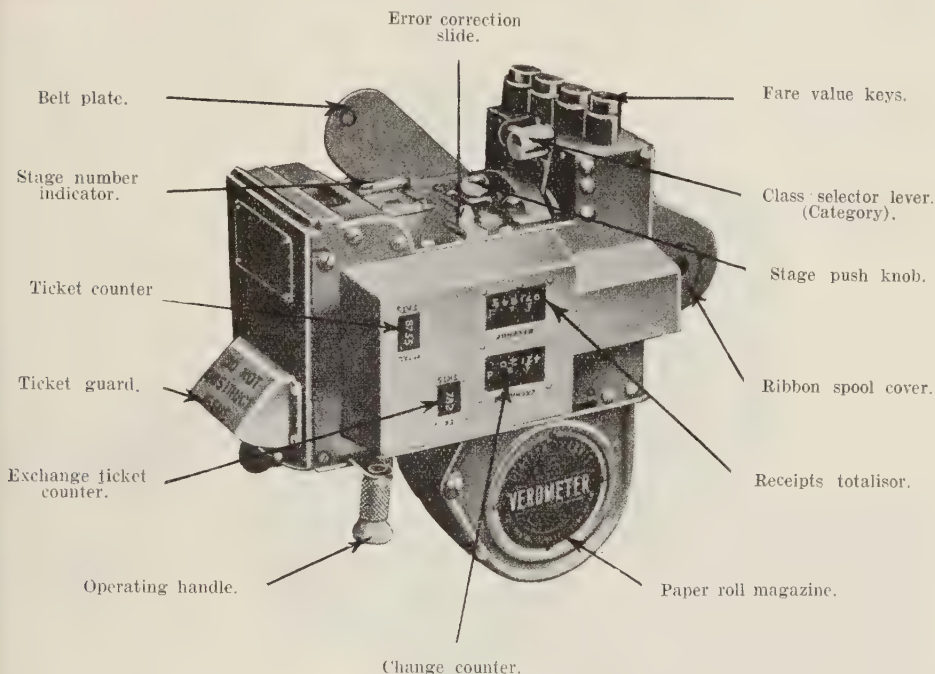


Fig. 741. — « Verometer » machine, Clayton-Harris system, made by Clayton, Dewandre and Co.

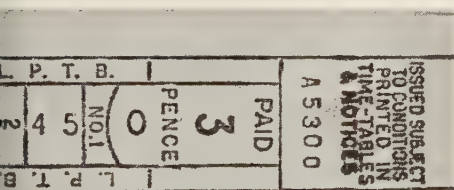


Fig. 742. — Paper ticket from Clayton-Harris « Verometer ». (Red. 3/4) — London Passenger Transport Board.

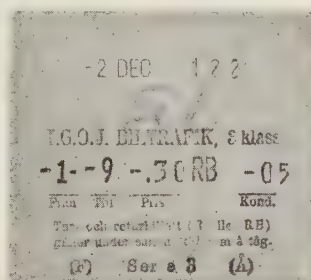


Fig. 743. — Soft card ticket from Clayton-Harris « Verometer » fixed machine. (Red. 3/4) — Grängesberg-Oxelösunds Ry. (Sweden).

R. The Clayton-Harris Verometer, made by Clayton-Dewandre and Co., was introduced in 1932. It also prints tickets on rolls of blank paper but unlike the I. M. which operates by rotary move-

ment, it does so by a forward stroke of an operating handle whose return stroke issues and guillotines the ticket (fig. 745).

The roll is carried in a magazine in the lower part of the machine and threaded

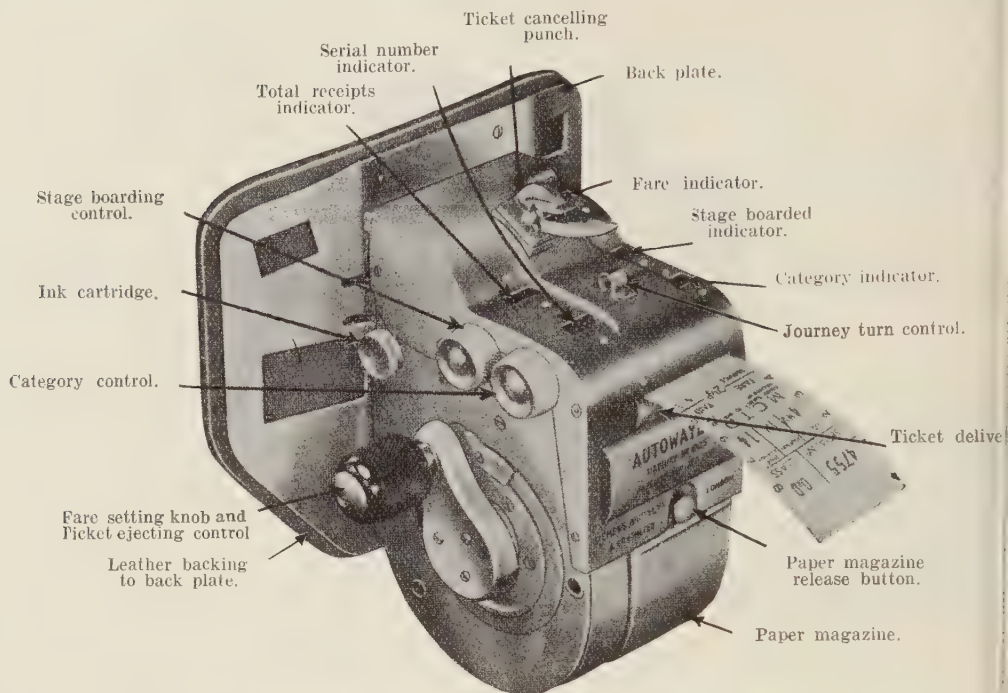


Fig. 744. — Portable « Autowaybill » machine, Siemens Bros. Ltd., London.

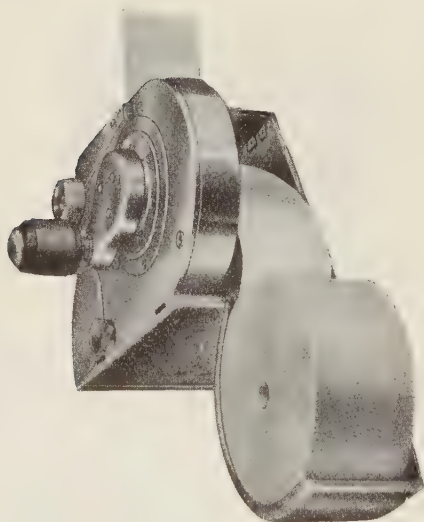


Fig. 745. — « Autowaybill » machine, without back plate, and with paper magazine open, showing large size of paper roll. (Red. 1/2).

over a roller which the operating hand moves. An ink ribbon travels between spools immediately above, and the type wheel is above that again. When pressing the lever, the grips and printing roller are released and when issuing, grips carry the printed ticket through the aperture and it is guillotined.

There are two models of verometer both having 4 keys for printing, the larger one having, in addition, a shilling key. The usual size prints 1/2-d., 1-d., 2-d. and 3-d. values giving 20 combinations from 1/2 d. to 11 1/2 d.; the larger can form 100 combinations from 1/2 d. to 19 sh. 11 1/2 d.

Any particular value can be obtained by diverse combinations; 6 d., for example, by pressing the 1-d. key six times, the 2-d. thrice, or the 3-d., twice. At each

operation, the printing key revolves until « 6 d. » finally appears.

A wheel revolving through pressing a button one way on the outward, the other in the return journey, gives the stage number.

A special lever that moves over a circular pawl and ratchet segment enables in classes of tickets (categories) to be issued.

The registers show total value and number of tickets issued against fares collected and also these items concerning exchange tickets, the revenue register of the latter not being included in the total revenue register.

On the tickets (fig. 742) are printed :

- The ticket number;
- The fare value;
- The category;
- The number of the machine;
- The stage;
- The route number.

These items differ from one ticket to the next. The fixed particulars — notation and the Company's name — are printed at the same time.

The cost of three rolls of paper from which 1,000 tickets can be printed is 1/2 d. per roll; each roll consists of a ribbon six yards long.

The short model Verometer machine weighs 5 lb.

It can be mounted in booking offices, as on the *Trafikaktiebolaget Grängesberg-Elösunds Ry.* in Sweden (fig. 743).

The Autowaybill ticket issuing machine (figs. 744 and 745) is manufactured by *Siemens Bros. and Co. Ltd.*, London. It is easy to operate and weighs 3 1/2 lb. Without belt and back plate, the depth is 4 1/8", the width, 4 1/4" excluding control knobs, and the height, including the cancelling punch

which is mounted on the top cover, 6 3/8".

The readings are taken through windows in the top cover. Apart from the

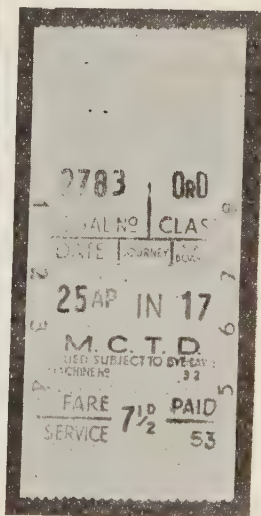
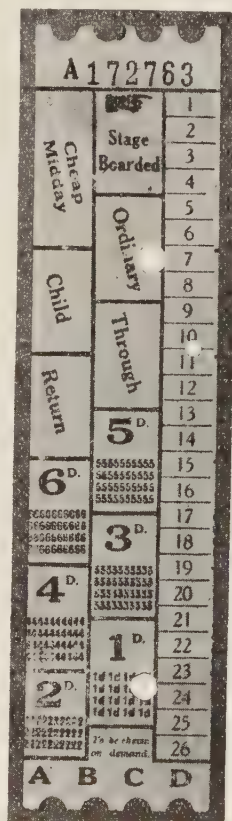


Fig. 746. — *Aspinall's Ticket Machine Ltd.*, tried by the *London General Omnibus and Associated Companies.*

Fig. 747. — « *Autowaybill* » ticket, *Siemens Bros.* — *Manchester Corporation Tramways.*

journey In/Out button and the cancelling punch, all the controls are on the right-hand side of the machine. The ticket is ejected horizontally by the delivery roller in the front of the machine.

The cancelling device consists of the punch, the die and the spindle connecting the two parts together. It is so constructed that to operate it the conductor takes the ticket between two fingers, slides it to the punch anvil so that the tapered part of the latter slides between the ticket and the finger, gives a slight twist and the punch is operated by releasing the hold of the ticket and without using the other hand. When necessary, it is a matter of seconds to withdraw the pin and touch up the punch face only with an oilstone, for resharpening it.

The right outer knobs control « class » and « stage boarded ».

The dual-purpose handle is depressed and rotated to set the « fare » and then turned on its own crank to print and issue the ticket; this accelerates the speed of issue.

The tickets are 2 3/4" long by 1 1/2" wide. The range they cover is as under :

Constant data :

Conditions of sale;
Number of the machine.

Data set at the depot :

Date — day and month;
Service — Any number required on detachable metal button in printing plate.

Set by operator in service :

Fare — 1 to 18 values, as 1 d. to 1 sh. 6 d. or 1/2 d. to 9 d., or similar series;

Class (category) — 8 classes : Ord. (ordinary), ReT (return), MD (midday), TrF (transfer), MiS (miscellaneous), EX (exchange), WkR (workman's return), CH. (child);

Stage boarded — 0 to 99;

Journey — In — Out;

Serial number — 0 to 9999, this being progressive.

With ordinary paper, the capacity of the machine is approximately 600 tickets; with thin paper, it reaches 1,000 per roll.

The machine is self-auditing; it records the total number of tickets used

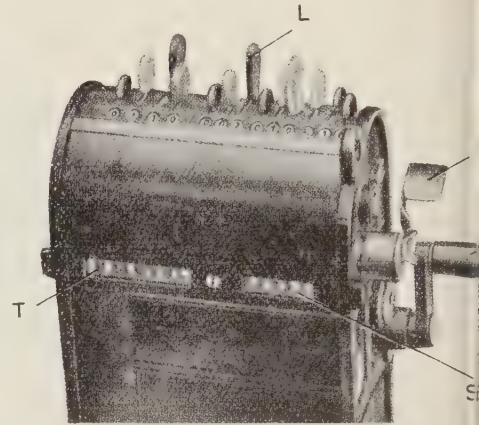


Fig. 748. — Portable machine made by British Westinghouse Ticket Machine and the A. E. G., for printing and issuing tickets as required.

and the total cash receipts displayed « Units ».

T. The Westinghouse portable ticket machine, made by the British Westinghouse Ticket Machine Co., London,

identical to that of the *A. E. G.* (figs. 748-750). (The dimensions quoted hereafter in brackets refer to the *A. E. G.* machines, the others to the English ones).

It takes the shape of an oval box similar to a large folding camera when closed and, in common with others, is slung by means of a strap. It is 9" long, 5 1/2" wide and 3 1/2" deep, and it weighs 5 lb. with control box, and 4 1/4 without. It can be carried without fatigue or fixed to the car, close to the driver.

The TICKETS (figs. 751 and 753), 2 3/4" x 2 1/4", are obtained from rolls, ejected through a slot in the front of the machine and torn off against a sharp serrated edge. Should several identical tickets be required, the main handle is turned a corresponding number of times and the complete set of tickets is torn off as one piece. Each roll contains enough paper for 300 (or 250) tickets and a new roll can be inserted without delay on a quick release spool on opening a large flap *F* at the front of the machine.

As the ticket has both variable and semi-permanent particulars, provision is made for setting the variable data by thirteen levers *L* of different lengths which protrude through the upper cover of the machine and control an equal number of discs of the printing cylinder. Together with the indicator openings, they are arranged in a straight line along the top of the machine and show :

The fare — 4 levers *S* are required to set up with 4 numerals each varying from 0 to 9 and a decimal point can be inserted if desired. In the English machines, the levers indicate numerals from 00 to 99 and from 00 to 1/2.

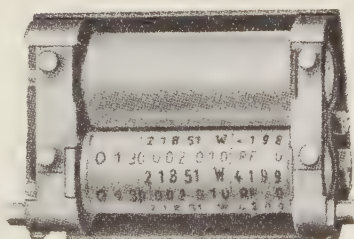
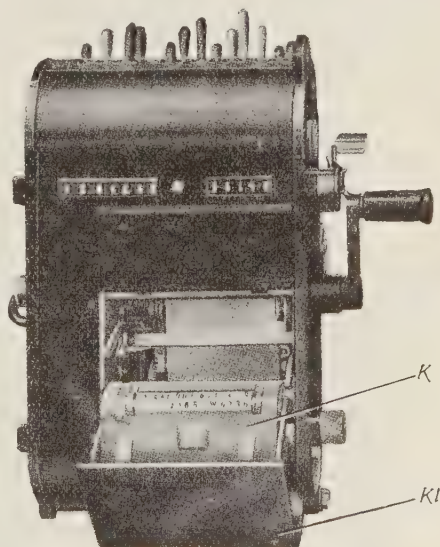
The stage — 3 levers indicating any number from 000 to 999 show where the car was loaded, and three others with the same range where it is to be left.

The class (category) is shown by an 8-position handle.

The time of issue is indicated within 30 minutes by means of the two last levers which show the hours from 00 to 24.

All these data are indicated without having to open the machine. The levers themselves are divided into groups ranging from left to right which can, of course, be modified to suit local requirements and they are moved forward or backwards against locking ratchets.

The information set by these levers is



Figs. 749, 750. — *British Westinghouse Co., Ltd.* and *A. E. G.* ticket printing and issuing machine.

**LONDON PASSENGER
TRANSPORT BOARD**

Fare	Stage boarded	Class	Time
05	03	*	27

Issued subject to the conditions and regulations of the Board in force at the time of issue. When issued as a return (Rt.) ticket it is available for return on day of issue to stage boarded, to be shown or given up on demand.

1	Service No.	Date	Number
	4 1 4 1 1	XI	1 3 2 0

1 6	18	*	07	
4 1 4 1 1	XI	1 3 3 1		
0 2	18	*	07	
4 1 4 1 1	XI	1 3 3 8		
9 6	18	*	07	
4 1 4 1 1	XI	1 3 3 9		
0 2	19	*	08	
4 1 4 1 1	XI	1 3 4 0		
0 4	19	*	08	
4 1 4 1 1	XI	1 3 4 1		
0 1	19	*	08	
4 1 4 1 1	XI	1 3 4 2		
0 1	19	*	08	
4 1 4 1 1	XI	1 3 4 3		

4 RF * 0.7 C

von	bis	Art	Preis	Linie
1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25
26	27	28	29	30
31				

Vorm. Nachm.

Vorm. Nachm.

Nur gültig bei gelochter Einstelzzeit
Kontr.Nr. Monat Tag

3505 OKT -3

Nun gültig bei gelochter Einstelzzeit

Vorm. Nachm.

Vorm. Nachm.

Preis Art Dat von bis Linie Kontr.Nr.

0.90 Rf 26x 10 19 7 8 3 5

Paper tickets from *British Westinghouse Bros.* and *A. E. G.* portable machines. (Red. 3/4)
 Fig. 751. — *London Passenger Transport* Fig. 752. — Fragment of check band.
 Board ticket.

Figs. 753, 754. — *Kraft-Verkehrs Ges. (Motor Transport Co.)* tickets showing category and period of availability by means of black spots.

printed in one line under suitable headings on the upper half of the ticket. The printing cylinder can further carry six or even ten supplementary printing discs for printing the semi-permanent particu-

lars on the lower part of the ticket when they appear in a second line including

- (a) Service number (000-999);
- (b) Date (00.I to 31.XII);
- (c) Serial number.

The first two of these items are set by means of a special pin (normally kept in loop in the shoulder strap) through an opening in the front of the machine. The serial number, of course, is automatically advanced, one for every ticket issued.

OPERATION AND ISSUE OF TICKET. —

When the required data have been set, and checked through the indicator windows, the machine is operated by turning the handle *H* on the right-hand side two or four revolutions. Normally this handle is locked and is released by depressing the release *R* immediately above it, which is so formed that the movements can be synchronised.

This release lever also serves as a key; when withdrawn from the machine, the ticket is locked.

RECORDING DEVICES (fig. 749). — The machine is provided with two revolution counters visible through small apertures at the back of the machine; the first of these is a totaliser *T* and records in millings and pence the cash value of each ticket issued. The other records the number of tickets issued and agrees with the serial number *S* actually printed on the ticket.

In addition, a complete duplicate record of both lines of variable data appearing on each ticket is printed on a separate recording strip contained in a sealed detachable unit (fig. 752). This record strip serves as a check on the cash totaliser and serial number counter and also provides exact information for statistical purposes if and when required. This is done by printing on it, in type identical to that of the ticket, and at the same time

the fare;
the trip-stage boarded and left;

The class (category);
The time;
The route number;
The date;
The number of the ticket.

The type remains locked during printing and is released immediately after.

This detachable unit contains sufficient paper for 700 records, and it is intended that conductors on routes where this number of issues is likely to be exceeded in one day or duty should carry a complete spare fully loaded unit for rapid insertion, should the paper in the one carried in the machine become exhausted. Two levers allow the roll to be changed. Should this be necessary the machine is locked and cannot be operated until a new record unit has been inserted.

INKING. — The inking of the variable and fixed type is done by one and the same inking roller which is itself designed as a small unit and serves also the secondary purpose of protecting the mechanism from unauthorised interference. For this reason, the inker can only be withdrawn for recharging by means of a key. One charge of ink is sufficient for approximately 15,000 tickets.

CANCELLATION OF RETURN TICKETS. — These tickets are inserted into the front of the machine, which will then, on operating it in the normal manner, cancel these tickets by printing on them any or all of the variable data which can be set by the levers already referred to. The original intention of this device was to provide means for printing supplementary fares on tickets which had previously been issued, so that all cash transactions on the route should be recorded on the machine.

OTHER TICKETS. — An inclusive fare can be printed on season tickets or on the cover of booklets of coupons. A slot which is normally closed and can be opened by a special push button, is provided for the purpose. The money taken is registered by the totaliser and recorded on the check band.

U. The Ohmer ticket-printing register, made by *Ohmer Fare Registers*, of Dayton, Ohio, differs from the former machines in not being portable. There are two types of them, one for fixing in cars, the other, in booking offices, both being hand- or motor driven (figs. 755, 756).

The former weighs 30 lb., is 12" high, 9 1/4" wide and 6 1/2" deep; the latter weighs 22 lb. and is only 6 1/4" wide, the other dimensions being the same.

Three standard sizes are supplied

To record up to 9 zones, with a cash capacity from 1 c. to 99 c.;

To record up to 99 zones, with a cash capacity from 1 c. to \$ 9.99;

To record up to 99 zones, with a cash capacity from 1 c. to \$ 99.99.

All have paper rolls sufficient for 2,500 tickets. The present cost of the rolls to the Company is 9.2 cents per thousand tickets.

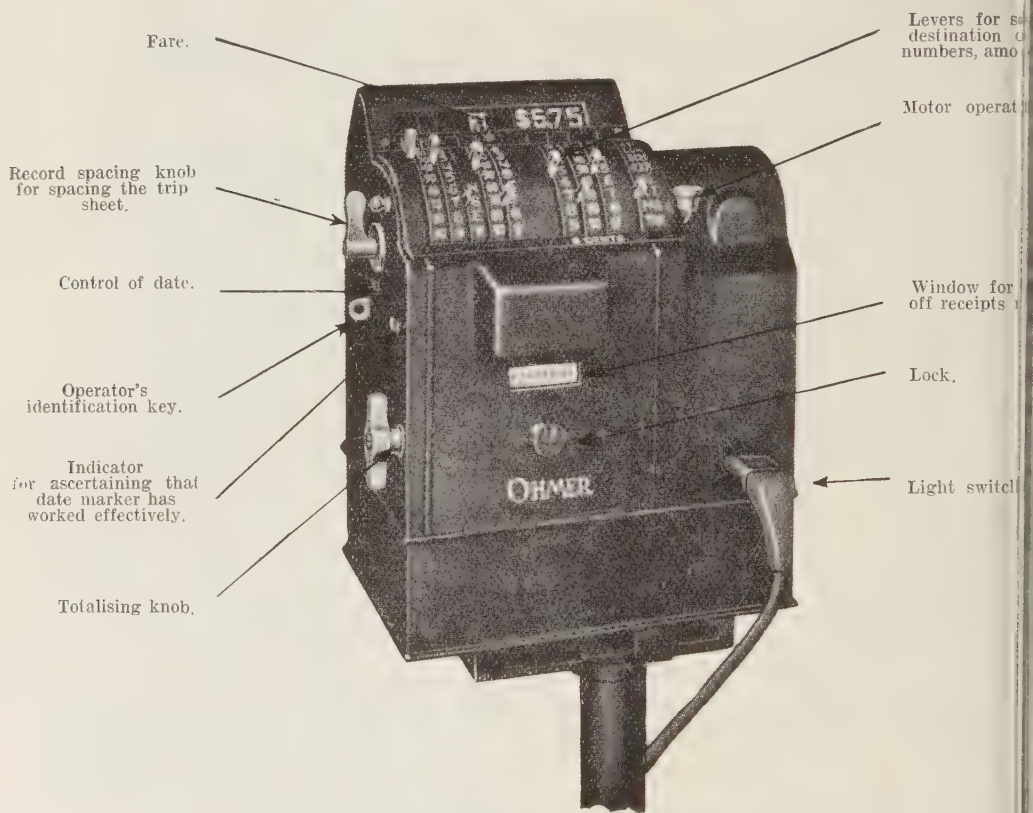


Fig. 755. — Front view of car type *Ohmer* ticket printing register for intercity and interstate operation.



Fig. 756. — Rear view of booking office type Ohmer « Ticket-printing Register », showing, on the left, the handle, on the right the fare (which also appears in front), and the ejection slot.

The INK ROLL is filled with ink similar to the filling ink of a fountain pen. Sufficient ink is supplied to the periphery of the inking rollers to print 200,000 tickets and records without refilling. The combination of ribbons is one of the machine's good points.

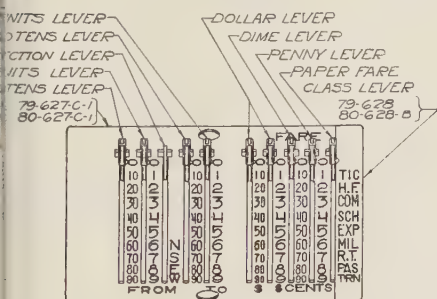


Fig. 757. — One arrangement of lever hand and top plan of an Ohmer « Ticket-printing Register » machine. (Red. 2/3).

26 FEB	6#FRNKLN	\$1.00	TRN	0	8	4	4	822
26 FEB	6#SHRNVL	\$3.45	FF	0	8	4	3	822
26 FEB	6#CINCTI	\$0.90	CLG	0	8	4	2	822
26 FEB	6#CINCTI	\$0.90	CLG	0	8	4	1	822
26 FEB	6#	READ R	\$1.55	FF	0	8	4	0 822
26 FEB	6#	READ R	\$0.80	HF	0	8	3	9 822
26 FEB	6#READING	\$1.00	HF	0	8	3	8	822
26 FEB	6#	PISGAH	\$1.77	SPL	0	8	3	7 822
26 FEB	6#	MASON	\$1.25	FF	0	8	3	6 822
26 FEB	6#SHRNVL	\$2.60	CLG	0	8	3	5	822
26 FEB	6#CNTY L	\$4.25	EXC	0	8	3	4	822
26 FEB	6#CNTRVL	\$0.47	EXP	0	8	3	3	822
26 FEB	6#	LEBNON	\$2.00	RT	0	8	3	2 822
26 FEB	6#	LEBNON	\$2.50	FF	0	8	3	1 822
26 FEB	6#	MONROE	\$0.85	HF	0	8	3	0 822
26 FEB	6#	MONROE	\$1.65	FF	0	8	2	9 822

IDENTIFICATION	MONTH	DAY	YEAR	DESTINATION	AMOUNT	CLASS	CONSECUTIVE NUMBER	REGISTER NO.
----------------	-------	-----	------	-------------	--------	-------	--------------------	--------------

Fig. 758. — Fragment of check band from 22-destination « Ohmer Ticket Printing Register ». (Red. 1/2).

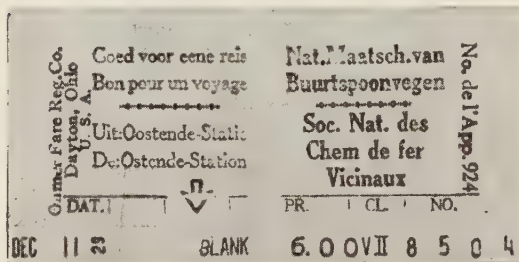
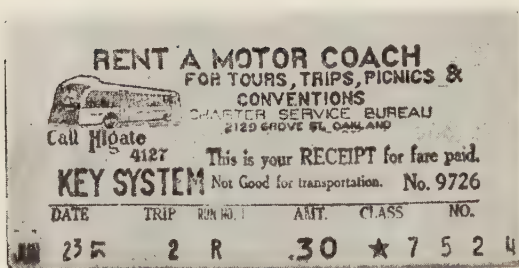
Destination names abbreviated to 6 letters each.

The TICKET CUTTER is a complete unit and has no springs. It is self-sharpening and positive in movement. It can be removed instantly, if necessary.

\$01982.21												
26MAR	-8	28	28	4	S	1	\$0.40		8	5	9	8 852
26MAR	-8	28	28	5	S	4	\$0.00	TR	8	5	9	7 852
26MAR	-8	28	28	7	S	1	\$0.00	CM	8	5	9	6 852
26MAR	-8	28	28	8	S	1	\$0.80		8	5	9	5 852
26MAR	-8	28	28	8	S	5	\$0.00	HI	8	5	9	4 852
26MAR	-8	28	28	1	S	1	\$2.70	RT	8	5	9	3 852
26MAR	-8	28	28	4	S	1	\$4.00		8	5	9	2 852
26MAR	-8	28	28	4	N	1	\$0.00	PS	8	5	9	1 852
26MAR	-8	28	28	3	N	1						852

Fig. 759. — Fragment of check band from an Ohmer 99-station machine — Direction of travel denoted by a letter. (Red. 1/2) — Totalised receipts down the centre.

- A — Operator goes on duty.
- B — CM — Commutation ticket (collected from station 7 to station 1, from a booklet).
- C — RT — Round trip ticket (sold from station 15 to station 1).
- D — Space between two trips, for convenience of auditing department.



Thin card tickets from *Ohmer Ticket-printing Register Co.'s* machines. (Red. 3/4).

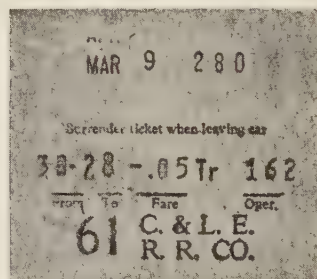
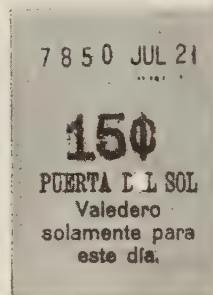
Fig. 760. — « Key System » ticket, San Francisco.

Fig. 761. — Ticket issued on sea coast lines of the *Belgian National Light Rys. Co.*

The DATE is set from the outside by a single key; the dating device is positive and functions similar to a perpetual calendar.

MECHANISM. — The variable elements in the machine and the type wheels are set by selective levers whose position is not changed during the act of registration (fig. 757). There are no gears, the entire movement of the type wheels being confined to that imparted to them by the levers, each of which sets up ten characters. With very little practice, the operator sets the levers by the sense of touch, checking himself when necessary by a glance at an indicator. The machine is

not cleared by the act of registering, if repeat tickets are wanted, not a single new adjustment need be made and no repeat key has to be pressed. Thus a lever set for 50 c. need not be changed to register \$ 1.50; only the dollar lever moved one space.



Tickets printed when issued, on thin card (Red. 3/4).

Fig. 762. — *Madrid Metropolitan Ry.*

Fig. 763. — *Chicago & Lake Erie R. R.*

The TICKETS bear the following particulars (figs. 760, 761) :

- The date (month and day);
- The departure station or zone;
- The destination station or zone;
- The direction of travel or a symbol showing it;
- The fare;
- The category (1);
- The number of the ticket;
- The number of the machine.

(1) The most generally used are :

TI (ticket); HF (half-fare); CN (commutation); SC (school); XP (express); MI (mileage); RT (round-trip); PS (pass); TR (transfer).

An auxiliary « category » wheel prints the direction of travel (North, South, East or West) or, if preferred, letters of code corresponding to sectors of the system or symbols allowing of any other statistics being established ⁽²⁾.

While printing the ticket, the machine records the same particulars on a DETAIL RECORD STRIP within the register on which the operator's identification key number printed from his identification key is added; of course, the Company's name and travel instructions are omitted from the record. As the register number and the consecutive number are both printed on the record opposite the operator's key number, the identity of the operator issuing any particular ticket can be readily ascertained.

The consecutive number being printed on both ticket and record and the dates corresponding on both of them, every detailed strip has complete information for identification (figs. 758, 759).

A PRINTING TOTALISOR with a capacity of 99,999-99 totals, at the same time, the amounts of all fares. These are mechanically computed and printed on the record in red ink at such intervals as may be desired, while the tickets and the record are printed in purple ink. These totals are thus easily picked out for auditing purposes.

METHOD OF OPERATION. — Normally, the machine is locked. When taking up work, the operator inserts his identification key. He sets up the date, makes an opening ticket (and record), moves the spacing lever and prints on the record the total

cash recorded up until the time he took over.

When a passenger enters, the operator sets the levers corresponding to the details of the ride which the passenger wishes to take. The amount of the fare he sets is very distinctly indicated both in front and rear in large white figures.

As soon as this fare is in hand, the operator presses the electric operating button which prints all the particulars, fixed and variable, identically on both ticket and check band. The end of the ticket then protrudes from a slot in front of the register. The complete ticket is seized by the passenger who keeps it until the end of the ride so as to return it to the operator.

When finishing the day's work, the operator moves the spacing lever until it is locked and then turns the totalizing knob one complete turn which act results in printing — again in red — the total amount of cash on the record. The difference between the first total and the present one represents the amount collected. This second total is exposed to the operator through a slight opening or it may be printed on the ticket the operator issues to himself at the beginning and end of each trip by its insertion through a slit in the ticket door.

V. The Ohmer booking office register (fig. 756) is similar to the car-type machine, but owing to its greater flexibility, it has a far wider range of tickets. In addition to the fixed particulars previously quoted (Company's name, notices, etc.), the tickets bear in large letters, the name

(2) The letters chosen as standard are those least easily confused with figures, viz. :
 For machines fixed in cars : A, B, D, E, H, K, L, M, N, R.
 For those in booking offices : A, B, D, E, H, K, L.

of the issuing station. Besides this, unless there be an excessive number of possible destinations, the latter are given in full or abbreviated to 6 letters; should

there be too many of them, a destination number is used.

The capacity of the six standard sizes is as follows :

TYPE.	Number of destinations.	How indicated.	Possible fares from 1 c. to \$	Number of categories.
A-T	99	Numerically.	9.99	9 + 9 auxiliary
B-T	999	Do.	Do.	9 + 9
C-I-T	999	Do.	99.99	9 + 9
12-S	12	By name.	Do.	9
22-S	22	Abbreviated.	9.99	9
11-S	11	By name.	Do.	9
	Or 99	Numerically.	—	—

As with the car type of machine, by combining the auxiliary category wheel with the position at which the levers can be set, any required combination can be formed by adding the designations « HF »

or « RT » (half-fare or return-trip). these tickets are not used, the letters can serve as code letters for sectors or as statistical data.

* * *

POST-FACE.

Tickets history. — In their century of existence, railways and road transport have evolved many systems and types of tickets which we have successively dealt with and which range from the original ones painstakingly made out to the hold- down to those electrically-driven ma-

chines print and issue instantan to the order of an anonymous patron.

We have not followed the chronological

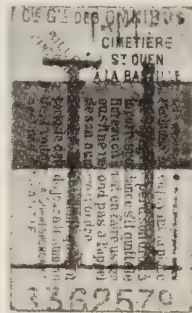
Retour	Aller	BEAURAING-DINANT E. MONIER — Prix
Dinant	Beauraing	
Anseremme	Baronville	
Falmignoul	Feschaux	
Falmagne	Jam. de bois	
M. St. Blaise	M. St. Blaise	
Jam. de bois	Falmagne	
Feschaux	Falmignoul	
Baronville	Anseremme	
Beauraing	Dinant	

8802

JOUR

Retour	Aller	BEAURAING-DINANT E. MONIER — Prix
Dinant	Beauraing	
Anseremme	Baronville	
Falmignoul	Feschaux	
Falmagne	Jam. de bois	
M. St. Blaise	M. St. Blaise	
Jam. de bois	Falmagne	
Feschaux	Falmignoul	
Baronville	Anseremme	
Beauraing	Dinant	

8802



Old road transport tickets. (Red. 4/5).
Fig. 765. — Card transfer, *Paris General Omnibus Co.*, 1857.

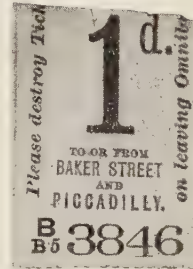
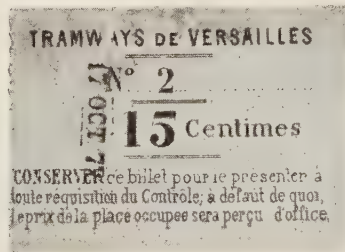


Fig. 766. — One of the first London tickets, used on the *Metropolitan Ry.*'s London buses.



Tickets of early French road transport concerns. (Red. 3/4).

Fig. 767. — *Versailles Tramways*, 1877.

Fig. 768. — *Marseilles General Omnibus Co.*, 1870.

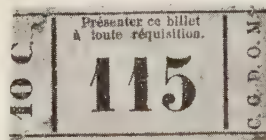
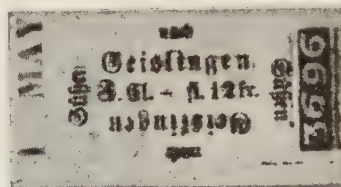
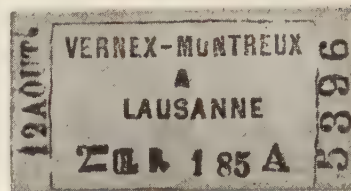
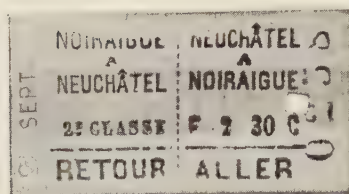


Fig. 764. — Ticket in use before the railway era — *Post Office Museum*, Brussels.

Fig. 764. — Ticket in use before the railway era — *Post Office Museum*, Brussels.



Old Edmondson tickets. (Red. 4/5).

Figs. 769, 770. — *Jura Railway* tickets (1850 and 1860).Fig. 771. — *Wurtemberg State Rys.* ticket (1865).

order as each element of the ticket has developed independently of the others. It is nevertheless interesting to list, were it only for the sake of comparison, the old tickets we have reproduced in our illustrations.

Lest we gloat over progress achieved,

we have added figure 764 showing a still older ticket which is a kind of ancestor of all others. This stage-coach ticket of the 18th century will come as a surprise to many, for it already embodied many of the features which still appear in the tickets produced 150 years later.

LIST OF ILLUSTRATIONS OF OLD TICKETS.

STAGE-COACH TICKET, XVIIIth century . . . 764

EARLY RAILWAY TICKETS, other than Edmondson's.

First Belgian paper tickets (1835 to 1840). Early British paper tickets (1832, 1841). Both are similar to the stage-coach tickets to which they succeeded . . . 1 to 5, 10, 47

RAILWAY TICKETS.

First German ticket, 1835 . . . 259
Old American tickets, 1850. . . 445-456
Old American coupon-tickets, 1853 to 1857 . . . 461 to 464

EDMONDSON CARD TICKETS.

Earliest British tickets, 1836 to 1838 . . . 49 to 51

Old British tickets down to 1856 . . . 54 to 155-156, 184, 444, 4

Old Belgian ticket, 1860. . . 1

Old English monogram tickets . . . 4 to 450, 5

Old Belgian monogram tickets, 1845 to 1860 . . . 58, 59, 151 to 1

Old German monogram tickets . . 451-4

Old Swiss tickets, 1860 to 1868 . . 769-7

Old German tickets, 1863 . . . 7

First ticket of Irak . . . 51

PASSES.

France — *Paris and Orléans Ry.*, 1844 . 3

England — *Great Western Ry.*, 1850 . 3

Belgium — *Obsolete Companies*, 1864 to 1870. . . 24-25-113-1

United States of America — *Erie*, 1870 . 3

Figures.

ACQUISITION WARRANT.

The Imperial Household (Napoleon III), 1858 410

RAILWAY TOURS.

Cook's, 1841 178

RAILWAY METAL OR IVORY TOKENS.

Gt. Britain, 1832 to 1845 . . . 127 to 131, 258

Canada, about 1855 128

Spain, ivory token, about 1860 . . . 40

British India passes 146-147

RAILWAY TRAM AND BUS TICKETS.

London. 19-174-218-766

Paris, about 1857 765

Figures.

Marseilles and Versailles 767-768

Lisbon, 1865. 102

Brussels, 1868 to 1873 . . . 100-104-108

Belgian provincial systems, 1873

to 1878. 105 to 107, 538

Germany, about 1870. 634

Spain, about 1870. 500-502-503

Italy, about 1870 96 to 99; 501

Brazil, Bahia, 1865 101

The Argentine, about 1870 203

U. S. A., 1886 357

OLD ROAD TRANSPORT TOKENS.

Sheffield, 1852 145

Canada, 1880 126

CONCLUSIONS.

1. Tickets should be adapted to operating requirements and conditions.
2. It is indispensable to reduce the number of different kinds of tickets now in use. Some systems have over 300 kinds!
3. Standardisation of the types of tickets and also of the various tickets of each type should be carried further.
4. Ticket letterpress should be simple and clear. It should be identical on all tickets of the same kind.
5. Careful printing and the use of good material is a safeguard against forgery.
6. Tickets issued by or to Agencies should be standardised and ought not to differ from those of operating Companies. The latter should provide the agencies with the tickets they require.
7. Ticket printing and issuing machines have indisputable advantages for auditing and statistics and often, even of speed.

Manufacturers will eventually build cheaper and sturdier machines for producing Edmondson tickets; when this happens, such machines are bound to come into general use.

Electrification of the Paris-Le Mans line, of the former French State Railways,

by JACQUES DUMAS,

Ingenieur, E. S. E.

(From *Le Génie Civil*.)

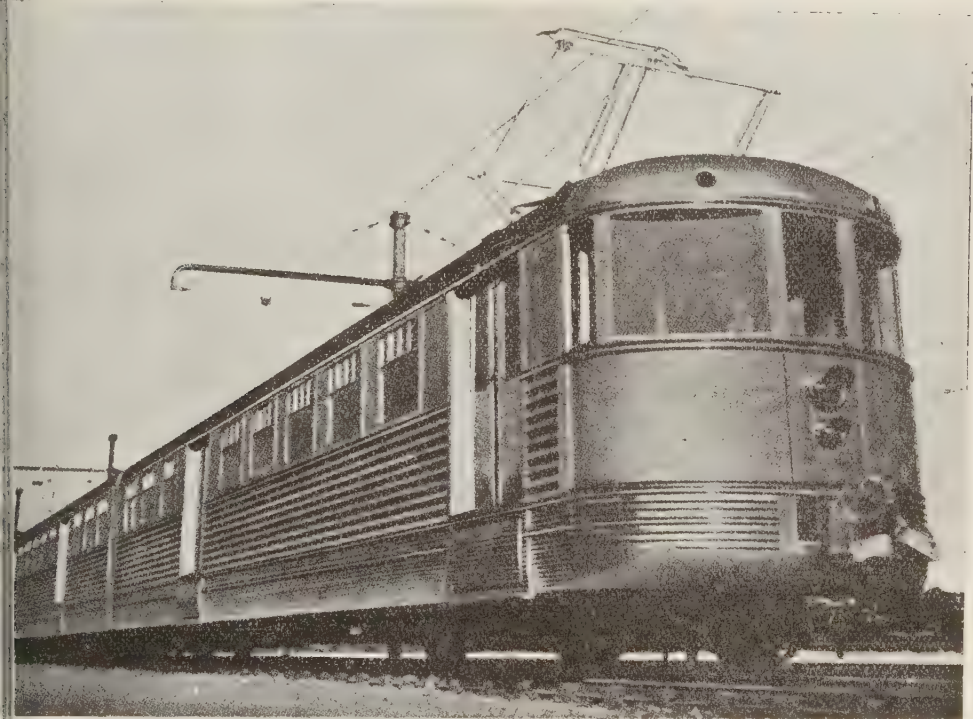


Fig. 1. — Electric traction on the Paris-Le Mans line, French State Railways : High-speed twin motor coaches in stainless steel, for outer suburban service.

Electric traction was brought into use on the Paris-Le Mans line of the French State Railways (now Eastern Area of the French National Railways Company's System) between Paris and Le Mans on June 10th, 1937. We give below the principal particulars of this work, the general scheme of which was drawn up by a Committee representative of the three chief

departments of the Railway under the chairmanship of Mr. Nicolet. The working details of the plan were elaborated under his direction and the guidance of Mr. Parodi, Consulting Engineer to the State Railways, by Mr. Garreau, Electrical Engineer, as regards motive power and rolling stock, and Mr. Vaubourdolle, Assistant Permanent Way Engineer, as

regards permanent way and works. It will be useful at the outset to give some brief particulars concerning the development of electrification on the State Railways system.

History of the electrification on the French State Railways.

In 1900 the former Western Railway of France used electric traction for the first time to haul trains between the Invalides terminus in Paris and the Champ de Mars station, on its new line from Paris to Versailles (Rive Gauche) ⁽¹⁾, which was arranged to be worked electrically from the beginning and was completed in 1902. In 1906 the State purchased the Western Railway and the State Railways extended electric working progressively, from 1924 to 1936, on all the inner suburban lines from Saint-Lazare station, Paris, to Versailles, Saint-Germain and Argenteuil.

In 1932, on the advice of the Higher Railway Council, the State Railways were requested, by an order of the Minister, to investigate the question of electrifying the two main lines, from Paris (St.-Lazare) to Havre, and Paris (Montparnasse) to Le Mans.

The results of this inquiry showed that the replacement of steam traction by electric traction would bring comparatively little benefit, and, in spite of its undeniable advantages, the adoption of the latter would no doubt have been long delayed had not a decree of May 15th, 1934, set in motion a big scheme of public works, known as the Marquet scheme, for reducing unemployment. A law dated July 7th authorised the State and the main-line Railways to share in these works.

The Paris-Le Mans line is that of the

State Railways on which traffic has increased with the most regularity for the last twenty years. Le Mans is at the centre of the system (fig. 2), and the working of the numerous lines radiating therefrom would be improved by electrifying from Paris to Le Mans, where Havre is a terminus. A comparison of costs also showed that the electrification of the Le Mans line was to give an annual saving of several millions compared with the Havre line, while it was desirable to give the suburban area of the Montparnasse station, the terminus of the Le Mans line, the advantages which experience had shown exist in the case of the similar area around St. Lazare station, terminus of the Havre line. Finally, the Le Mans line is adjacent to the electrified line of the Paris-Orléans ⁽¹⁾ system, which

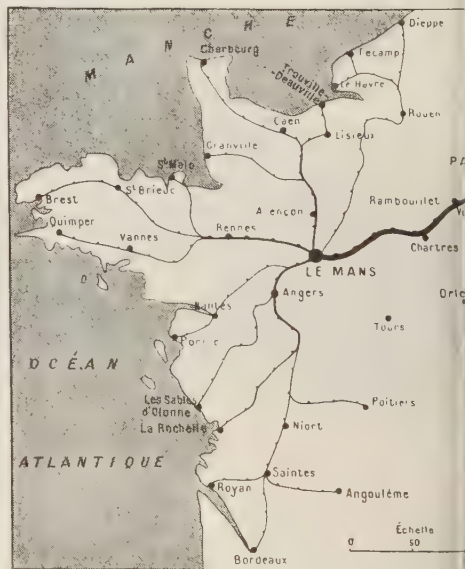


Fig. 2. — Map showing the position of the town of Le Mans in the State Railway System.

⁽¹⁾ This, the first electrification effected in France, was described in the *Génie Civil* of July 6th, September 14th, and October 26th, 1901.

⁽¹⁾ See in this connection the issues of *Génie Civil* for December 25th, 1926, and January 29th, 1933.

the Havre line obtains coal from the North at a cheap rate and serves numerous refineries furnishing oil fuel under the best conditions for the operation of diesel locomotives and railcars.

For all these reasons, the State Railways selected the Le Mans line for the first stage of its electrification plan, a choice approved by the Minister of Public Works, on July 15th, 1934. The first proposal, submitted on August 31st, 1934, contemplated an outlay of 476 million francs, a figure which was reduced to 403 millions and approved by Ministerial decision on November 21st, 1934. The laying of the first stone of the new works had, however, already been performed on October 3rd, 1934, by the retired President of the French Republic, the late Mr. Gaston Doumergue.

Principal features of the Paris-Le Mans electrification.

Quadrupling of tracks between Paris and Versailles. — The suburban train service from the Montparnasse station,

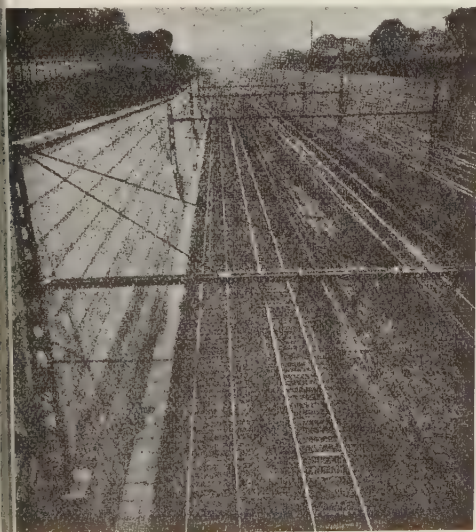


Fig. 3. — View of a cutting in the Paris suburban district, showing four-track line.

considerably increased as a result of electrification, could not be accommodated on the same tracks as the main-line service. It was essential to prolong as far as Versailles the four tracks already existing between Paris and Clamart, and this had to be done before electrification could be commenced. This work of quadrupling a line running through a thickly populated suburban district necessitated the enlargement of numerous embankments and cuttings in difficult ground (fig. 4); as well as the reconstruction of bridges, sometimes necessitating the realignment of roads crossing the line, and the rearrangement of the stations served; in particular the Meudon viaduct had to be enlarged, as described in the *Génie Civil* for August 22nd, 1936. At the same time the level crossings have been abolished and replaced by large bridges and foot-bridges.

The details of the work have been the subject of most careful attention throughout, with the object of producing the effect of architectural unity, free from monotony. Thus all concrete retaining walls in cuttings have the same reticular facings.

Beyond the four-track section, which goes as far as Trappes, an important marshalling yard 10 km. (6.2 miles) beyond Versailles, certain stations have been modernised, in particular Rambouillet, Chartres and Le Mans, the layout of the tracks has been improved and long reception sidings, called running sidings, have been put in every 30 km. (18.6 miles), to allow of slow trains being overtaken easily without stopping.

Electric power supply. — The question of the production and transmission of the necessary electric energy was simplified by the fact that there were already three distributing stations near the line (fig. 4): the Elancourt station, near Trappes, on the 60 000-volt net-

work fed by the steam generating stations of the Paris district and on which the transmission lines from the Rhine, the Alps, and the Central Mountain Mass converge, then the Luisant station near Chartres, and the Arnage station near Le Mans, which receive power at 90 000 volts from the Central Mountain Mass and the Pyrenees.

stations at Courville, La Loupe, Condé-sur-Huisne (figs. 5 and 6), Le Theil, Sceaux-Bossé and Pont-de-Gennes.

This method of feeding each sub-station by two entirely distinct lines, both fed at each end, ensures very great reliability.

Even should both lines be simultaneously interrupted at any point, n

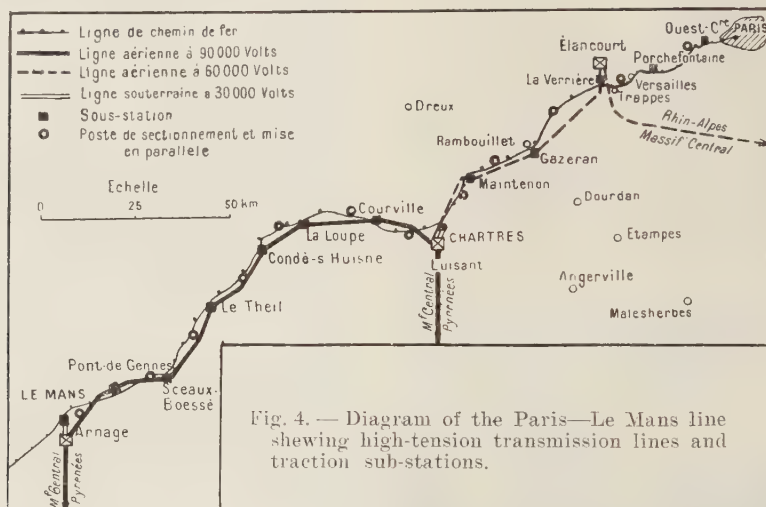








Fig. 4. — Diagram of the Paris—Le Mans line shewing high-tension transmission lines and traction sub-stations.

Explanation :

 Railway line.
 90 000-volt overhead line.
 60 000-volt overhead line.
 30 000-volt underground line.

 Sub-station.
 Sectioning and paralleling cabin.
 Echelle = Scale.

The State Railways contented themselves, therefore, with negotiating with the Companies owning these stations, for the supply of power to the terminals of the traction sub-stations on the Paris—Le Mans line, 13 in all. Four overhead transmission lines were constructed for this purpose, two at 60 000 volts, running parallel between the Elancourt and Luisant stations, which feed the La Verrière, Gazeran and Maintenon sub-stations, and two other parallel lines at 90 000 volts between the Luisant and Arnage stations, which feed the six sub-

sub-station would be left without a supply; for that to happen both lines would have to be interrupted at two points on each side of the sub-station.

Owing to the difficulty of bringing high-tension overhead lines into important built-up areas, the two sub-stations at Chartres and Le Mans are fed directly from the Luisant and Arnage distributing stations by two 30 000-volt underground cables, used for some years past to supply power to local distribution mains.

The two first sub-stations out from

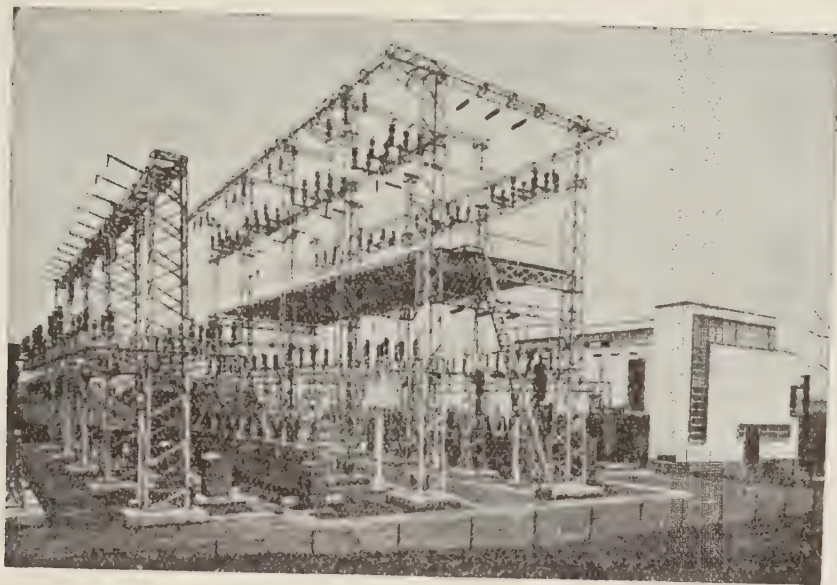


Fig. 5. — Exterior view of Condé-sur-Huisne sub-station showing high-tension equipment and building.

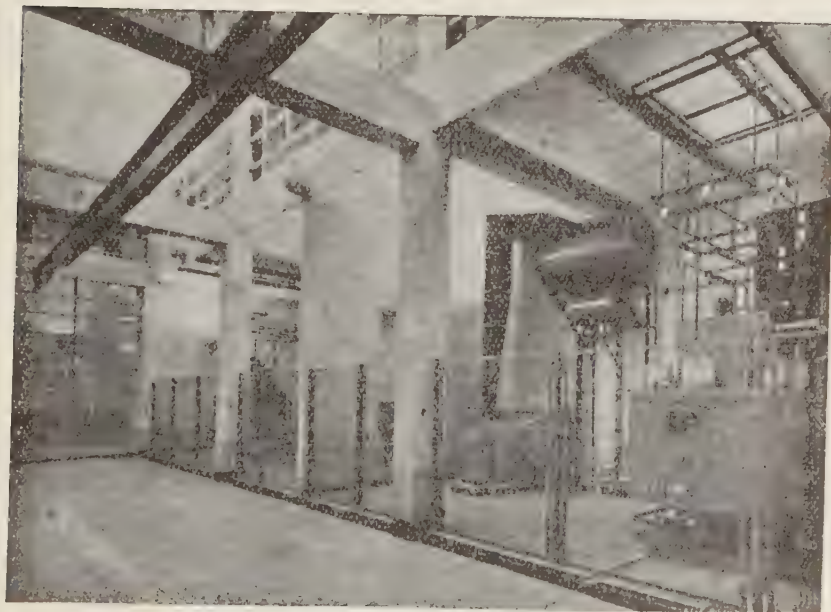


Fig. 6. — Interior of Condé-sur-Huisne sub-station showing mercury-arc rectifier bays.

Paris, the Ouest-Ceinture and Porche-fontaine, are alongside the existing ones supplying the 700-volt d.c. suburban lines and are fed from the 15 000-volt underground cables of the State Railways' suburban electrified system.

Traction sub-stations. — The traction current is distributed to the overhead contact lines from 13 sub-stations, 11 being main-line ones and placed at an average distance of 17 to 18 km. (10.6 to 11.2 miles) apart, and 2 suburban ones, exceptionally near together owing to the density of the traffic in the environs of Paris. The sub-stations are connected in parallel to the high-tension feeders, except those at Gazeran and Condé-sur-Huisne (figs. 5 and 6), placed respectively near the middle of the 60 000 and 90 000-volt transmission lines, and which serve as sectioning stations for them. All are of the semi-open type, i.e. the high-tension equipment is placed out of doors and the medium-tension equipment in a building. The high-tension three-phase alternating current is there stepped down to 1500 volts and rectified for feeding to the contact wires.

Each sub-station comprises two 2 000-kw. mercury-arc rectifiers with polarised grids and compound characteristic, except the two suburban sub-stations, which contain three 2 750-kw. sets. These rectifiers were preferred to rotary converters, as being more efficient at varying loads. The anode ignition is effected with a variable angle of lag, in order to compensate for voltage drop caused by changes in the load. The equipment is self-acting, the rectifiers being started and stopped automatically in accordance with the contact wire voltage and the 1 500-volt circuit breakers being reset similarly, after the insulation of the contact wire has been verified.

All sub-stations and sectioning cabins are worked from a sub-station regulating post in a special building in the Moyparnasse station, Paris, each contact being provided with a return indicator appearing on a diagram showing all the connections concerned.

Contact lines. — The catenary used on the running lines (figs. 7 and 8) is similar to that which has already proved



Fig. 7. — Sectioning and paralleling cabin, with gantry for lead-off from contact wires.

satisfactory on the former Paris-Orleans system and comprises :

— A main carrier cable in high-conductivity bronze, having a tensile strength of 70 kgr./mm² (44.4 Engl. tons per sq. in.) and a cross sectional area of 166 mm² (0.267 sq. in.), equivalent to one of 81 mm² (0.126 sq. inch.) in copper;

— An auxiliary carrier cable, in copper, of 104 mm² (1.61 sq. in.) cross sectional area;

— Two copper contact wires of 7 mm² (0.156 sq. in.) cross sectional area, forming a total cross sectional area equal to 400 mm² (0.62 sq. in.) of copper.

The duplication of the contact wires allows, on the one hand, of a reduction in contact resistance on the pantographs and, on the other hand, of replacing a wire without interruption to traffic. The contact wires are suspended from the auxiliary carrier by hangers of fixed

length, attached to each wire alternately and of stirrup shape, enabling the wires to move relatively to the auxiliary carrier wire and their tension to be automatically regulated by counterweights. The auxiliary carrier cable is in turn suspended from the main one, which has a deep sag, by hangers of hard round copper wire, of such lengths as to maintain the auxiliary cable horizontal.

The catenary is secured to its supports by double-element Hewlett insulators which carry the main carrier cable. To limit excessive oscillations that might arise from wind, tubes of adjustable length are provided, secured through insulators, at one end to the supports and at the other to the auxiliary cable; on curves, adjusting attachments are used to keep the contact wires in the same vertical plane as the auxiliary cable (fig. 8).

The whole catenary is used to convey the current; in addition, between Montparnasse Station and the La Verrière sub-station the heavy current called for



Fig. 8. — Arrangement of contact wire equipment on open track.

by the frequent train service has necessitated the catenary being supplemented by a feeder of 262 mm² (0.406 sq. in.) cross sectional area, supported on the same insulators as the main carrier cable. Sectioning and paralleling cabins for the contact wires have been provided about midway between sub-stations; the sectioning is effected by overlapping the ends of the two sections, the catenaries being fixed alongside each other, as seen in figure 7.

The catenary supports are fixed at intervals varying from 27 m. (88.6 ft.) on the sharpest curves to 63 m. (203.4 ft.) on straight track. As a general rule there is separate equipment for each track, the supports being mostly formed of light steel lattice girder bracket posts, the brackets having parallel faces (fig. 8). Gantries have only been used where really necessary, notably for leading off to the sectioning cabins (fig. 7).

On secondary lines the catenary is simplified by the suppression of the auxiliary carrier cable; in some cases the main cable is also abolished and the contact wire or wires carried directly by a transverse cable secured to the supports.

Colour-light signalling. — In order to derive the greatest possible benefit from electrification, the old mechanical signalling has been replaced by automatic block with colour-light signals. For these a perfectly constant power supply is essential, so that drivers shall not encounter unlighted signals. Multiple precautions against failure have therefore been taken.

The alternating current signal supply at 3 000 volts is furnished by a transformer in each sub-station and distributed by two feeders laid alongside the line in a concrete conduit let into the ground. Should one fail the other instantly takes its place, while each can be fed from either of the sub-stations at its ends. Finally, should the high-tension supply

fail, a diesel-electric generator set automatically started up and provides the necessary signal current in less than five seconds. This is the first installation of the kind.

The signals themselves are fed with current at 110 volts, being branched off the 3 000-volt feeders through two transformers, one being in reserve and replacing the regular one immediately should that become defective.

Rolling stock. — The State Railways have purchased on the one hand 15 high-speed locomotives, and 35 goods locomotives, and on the other 20 suburban twin motor coach sets and 5 other coaches known as pick-up coaches. The express locomotives are of the 2 D type (fig. 9), similar to those running on the Paris-Orléans System. They have an all steel body solid with a rigid frame carried centrally on four independent driving pairs of wheels, and a carrying and guiding bogie at each end with controlling device facilitating the taking of curves. The body comprises a driver's compartment and pantograph at each end and a central compartment containing the 4 traction motors carried on the frame and each driving an axle through double-sided gearing on the Büchli system.

The power of these locomotives is 3 400 H.P. at continuous rating and 3 800 H.P. at hourly rating; their total weight is 130 t. (128 Engl. tons) and adhesive weight 80 t. (78.7 Engl. tons); they can haul a 500-t. (492 Engl. tons) train at 150 km. (93 miles) an hour on the level, and a 700-t. (689 Engl. tons) train at 130 km. (80.8 miles) an hour on the level, or 110 km. (68.3 miles) an hour in 1 in 167 gradient.

The goods locomotives are of the 1 D type, the total weight being available for adhesion (fig. 10); they are similar to those in service on the Midi System. They comprise a rigid body resting on the two two-motor bogies, the coupling

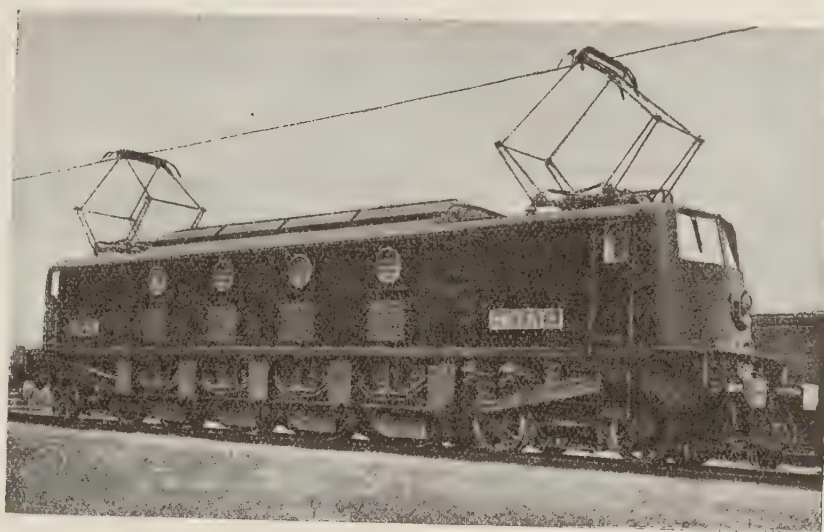


Fig. 9. — 3 800-h.p. 2-D-2 type high-speed locomotive.



Fig. 10. — 2 000-h.p. BB. type goods locomotive.

between the bogies being fitted with springs, the load on which can be adjusted, resulting in a steady riding locomotive. The bogies also carry the buffer and draw gear fittings, freeing the body of all strain in this respect.

Each axle is driven by a nose-suspended motor, with double-sided gearing. The body includes a driver's compartment and pantograph at each end and the equipment allows of two of these locomotives being coupled together.

Each locomotive is of 2 000 H.P., weighs 80 t. (75.7 Engl. tons) and can attain a maximum speed of 95 km. (59 miles) an hour.

A feature peculiar to both types of locomotive is the Bianchi dead man's control equipment, which makes use of the instinctive movements made by the driver in preserving his balance to keep it out of action; left to itself it would stop the train in less than a kilometre (0.6 mile).

The so-called *pick-up motor coaches* are formed of a light body solid with the under frame and carried on two four-wheeled bogies, a nose suspended motor driving each axle individually.

These motor-coaches have a total weight of 37 t. (36.4 Engl. tons) and a one-hour rating of 800 H.P., or continuous rating of 600 H.P.; their high power of 18 H.P. per ton allows them to attain 130 km. (80.8 miles) an hour and to give a commercial speed of 75 km. (46.6 miles) on sections where stops are made at stations on the average 7.5 km. (4.66 miles) apart. A well designed combination of the air brake with a rheostatic brake enables a deceleration of about 1 m. (3.28 ft.) per sec. per sec. to be obtained.

The suburban twin coaches (fig. 1) are in stainless steel, 18 % chromium and 8 % nickel. They are formed of two articulated bodies connected by bellows and carried on three four-wheeled bogies, a nose suspended motor driving each axle individually. This method of

construction was chosen after a visit to the United States by Mr. Nicolet, Assistant Chief Mechanical Engineer of the French State Railways. These sets weigh 64 t. (63 Engl. tons); they have a continuous rating of 1 200 H.P. and one-hour rating of 1 500 H.P. They can perform the same service as the pick-up type and have the auto-variable air brake and Boirault-Compact couplings as described in the *Génie Civil* for February 27th, 1937.

Working. — With the introduction of electric working on the Paris-Le Mans line, the passenger train service was completely reorganised. The long-distance stopping trains, both slow and costly to run, have been replaced by motor coaches connecting the principal stations served by the fast trains and expresses, the number of which has been increased to give a frequent and rapid service.

The main-line service is provided by through trains covering the 211 km. (131.1 miles) in 2 h. 15 m. and semi-through trains, stopping at the nine principal stations. The intermediate stations between Rambouillet and Le Mans are served by the pick-up motor coaches.

The suburban service between Paris and Rambouillet has been organised on the zone system, which has proved satisfactory in the suburban district round St. Lazare station. This consists in dividing the suburban area into several zones and attributing to each zone a class of train serving all stations therein, but running non-stop past all those in the preceding zones. The end of the first zone is at Clamart, of the second at Sèvres, and the third terminates at Rambouillet.

The traffic is regulated by the dispatcher stationed at Montparnasse station alongside the sub-station controller in cooperation with whom he takes whatever steps are necessary, should an incident arise.

Steam locomotives for high speeds,

by KARL GÜNTHER, Direktor bei der Reichsbahn.

(From *Glaser's Annalen*.)

The high speeds which are nowadays being demanded of steam locomotives necessitate a reduction in the deadweight, a widening of the radius of action, a decrease in the periods of time lost, an improved utilisation of locomotive supplies, continuous lubrication, the proper guiding of the locomotive along the track, and a more rationally designed motion.

It is not proposed in this article to enter into a description of the high-speed locomotives which have already been built or are under design, because almost all of them have been described in the technical press. Our object here is rather to state the conditions which must be fulfilled by locomotives which are required to haul trains at the higher speeds which at present appear to be desirable. When fast railcars, capable of maintaining a speed of 160 km. (100 miles) per hour, were put into service four years ago, it appeared at first sight that the steam locomotive was out of the question for hauling such fast trains. From the inception, the principle of as light construction as possible had been applied in designing railcars, and their streamlined forms had resulted in a considerable reduction in air resistance. Consequently, for the purpose of acceleration and propulsion at high speeds, they required only a relatively moderate power. The lengthy preparations for service which take up so much time in the case of the steam locomotive are not required in the case of the diesel engine, by means of which the railcar is driven. The mileage of which the diesel engine is capable is not limited by the waste products of combustion, whereas in the case of the steam locomotive the grate becomes clogged up after a more or less long run. The supplies for the operation of the railcar only represent small quantities. On long journeys, the fuel consumed has a very high calorific value and is used in an engine of high efficiency.

Even for the very longest run, it is not necessary to refill with water and oil. Moreover, as the railcar can run in either direction at the same speeds, without being turned, this results in fewer shunting movements in service.

If high-speed steam locomotives are nevertheless being constructed to-day in spite of the great advantages offered by railcars the principal reason for this is to be found in the restricted carrying capacity of railcars, so that a great influx of passengers can only be dealt with by coupling several of these vehicles together.

Moreover, it will not be possible, to any large degree, to replace the present corridor coaches (the stock of which must be able to meet passenger traffic peaks) by railcars which are high in initial costs. In addition, for fast services, the running of through international carriages cannot be definitely abandoned. To enable the railcar to afford the degree of comfort demanded for long journeys, it is necessary to reduce its useful passenger carrying capacity, and consequently increase its weight per passenger carried. Finally, the greater part of the liquid fuel used in internal combustion engines must, for the present at least, be obtained from abroad, and paid for in foreign currency.

The comparison with railcars furnishes a basis for determining the conditions which have to be fulfilled by steam locomotives for very high speeds. The question to be looked into, therefore, is whether the steam locomotive,

which is over a century old, is meeting all requirements from the service, economic and constructional points of view, in the form in which it has hitherto proved its worth.

The most important question, and the one that must be gone into before any other, is to ascertain the maximum speed at which trains hauled by steam locomotives will henceforth be called upon to run. The choice of the maximum speed to be adopted with advantage will be subordinated above all to economic considerations. Any idea of fixing this limit once and for all cannot, of course, be entertained.

In hilly country, it is hardly possible, on account of the up gradients, but still more because of the numerous curves, to maintain high speeds over long runs. The time saving effected for the journey decreases more and more in proportion as the speed laid down rises, and soon ceases to compensate for the considerable expenditure entailed by the additional increases in the speeds. It will thus be advisable in this case for the fastest trains not to exceed the maximum speed of 130 to 135 km. (about 80 to 84 miles) per hour. As regards locomotives which are intended to haul trains running through hilly country, a maximum speed of 140 to 150 km. (87 to 93 miles) should therefore be provided for.

On the level, the necessity of being able to bring the train to a standstill in a distance of 1 000 m. (1 100 yds.) with brakes using only the friction between wheels and rails limits the maximum speed, in the present stage of technique, to 150 km. (93 miles) per hour. If higher speeds are required, the distance from the distant signal to the stop-signal must be increased to more than 1 000 metres to ensure obtaining the necessary stopping distance, or otherwise the vehicles must be equipped with electro-magnetic rail brakes which enable the stopping distance to be reduced even in the case of still higher speeds. Now, the electro-

magnetic brake increases the weight and cost of the vehicles and restricts the districts in which they can be run. There is no room on the locomotive, between the wheels, for fitting electro-magnetic rail brakes of sufficient power without lengthening still further the already very long wheelbase.

Locomotives which are intended for running at 150 km. (93 miles) per hour must be constructed for a running speed of about 170 km. (106 miles) per hour. This margin will have to be allowed in the designs in order to avoid repairing the locomotives too frequently, an advantage which always happens with rolling stock which is often run at the highest permissible speed.

At the speed of 150 km. (93 miles) per hour, the steam locomotives must, on level, be capable of hauling a train of about 250 to 300 tons. In order as far as possible to reduce the time lost which take place at starting after a stop or after slowing down, the locomotive must be capable of accelerating with the load up to 150 km. per hour in a comparatively short time. When hauling the train in question, the locomotive must be capable of covering a mileage of about 600 km. (375 miles) without stopping on fresh supplies, without cleaning out the fire, and without any supplementary oiling, if it is desired to avoid long stops, the result of which would be a further increase in the time allowed for the run, which time has been shortened at considerable expense.

The faster a locomotive runs, the shorter becomes the time taken for the journey. On the other hand, the time absorbed by the operations carried out before the start and at the end of the run in taking on coal and water, inspecting the engine, cleaning out fires, tuning the engine, etc., has, up to the present, increased in proportion as the locomotive has grown larger, and as parts fitted on the locomotive have increased in number; and this time stands in a very unfavourable ratio to the

ring which the locomotive is hauling the train. It, therefore, becomes necessary to cut down the time losses of this description, and make it possible for the locomotive to make long runs without stopping.

The point now is : In what measure do the locomotives which have been built to date satisfy these conditions ?

More than thirty years ago, the 4-4-4 type 3-cylinder compound express locomotive, of the Prussian State Railways, built in 1904 by Henschel & Son, had already shewn that it was capable of hauling a train of 160 t. (157.4 Engl. tons) at 144 km. (89.5 miles) per hour. The Prussian 4-cylinder superheated express compound locomotive S. 2/6, in 1906 attained a speed of 154 km. (95.7 miles) per hour. Beyond all doubt, therefore, the steam locomotive was already able, at that time to haul trains at high speeds. The efforts which were then made to increase speeds were not followed up, the reason is undoubtedly that the need for such rapid transport did not exist.

Similarly, the first locomotives intended for running at 175 km. (108.7 miles) per hour — we refer to the locomotives series 05 and series 61, described in *Nachsbahn*, No. 10 of the 6th March, 1935, and No. 3 of the 15th January, 1936, and also in *Organ*, No. 3 of 1936 — gave complete satisfaction as regards speed. On the 11th March, 1936, locomotive 05

succeeded in attaining a speed of 200.4 km. (124.5 miles) per hour with a train of 200 t. (196.8 Engl. tons). The locomotive series 61 proved itself capable of hauling the streamlined 125 t. (123 Engl. tons) train specially built for it, at a maximum speed of 185 km. (115 miles) per hour on the level. These results went to prove that the steam locomotive, far from having outlived its period of usefulness, is still destined to furnish the principal means of propulsion on railways. But, on the other hand, the trials which had already been carried out enabled certain facts to be established which will have to be taken into account in future designs.

The train hauled by the 05 locomotive, the weight of which in full working order is 115 t. (112.2 Engl. tons), weighs 250 t. (246 Engl. tons). The locomotive series 61, weighing 128 t. (126 Engl. tons), hauls a train of 125 t. (123 Engl. tons). There therefore exists between the weight of the train and the weight of the locomotive a very unfavourable ratio; and consequently, it becomes absolutely necessary to reduce the weight of the locomotive very appreciably, the power remaining the same. Great progress has undoubtedly already been made in this direction during recent years. For example, the weights of the following locomotives, including the tenders, with 2/3rds coal and water supplies are as under :

the P. 8 locomotive (speed 100 km. = 62 miles per hour),	186 kgr. (415.7 lb.)	per H.P.c.
» S. 101 » » » » »	158 » (338.2 lb.)	»
» 01 » » » » »	101.5 » (353.1 lb.)	»
» 03 » » » » »	124 » (277.1 lb.)	»
» 05 » » » » »	111 » (248.1 lb.)	»

There was, however, an increase in weight in the case of the latest locomotive designed for a speed of 160 km. per hour (100 miles), this having risen to 339.7 kgr. (339.7 lb.) per H. P. e.

The heaviest part of the locomotive is the boiler which, for over 100 years, has served the shape given to it by Stephenson. It will be difficult to replace

this ingenious construction by a better one which will meet all service conditions. Stationary boiler design has been taken as an example. The desire to obtain high evaporative power, with a low weight, within reduced overall dimensions, has led to the construction of boilers with closed circuits or forced circulation of the water, to an appre-

ciable increase in the velocity of the combustion gases, and to the use of large radiation heating surfaces. Success has moreover been obtained by increasing, in a very large measure, the specific production of steam in relation to the weight and size of the boiler, and at the same time improving the efficiency of the latter.

With regard to the construction of locomotive boilers, it will be necessary to take advantage of the lessons to be learned from the results obtained with stationary boilers.

So long as locomotive boilers will have to be fired with coal, which demands a certain length of time to ignite and burn, it will be necessary to demand a large degree of flexibility from the locomotive boiler, from the point of view of evaporation, and consequently a great capacity for accumulation will be required. It is true that firing with pulverised coal, such as is being experimented with on the latest German State Railways streamlined locomotive No. 05 003, enables the rate of firing to be promptly controlled; but the use of pulverised fuel presents difficulties, because it cannot be stored in sufficient quantity, and its production in stationary plants is expensive, and has other disadvantages. It will only be possible to use pulverised fuel on a large scale for locomotives if the coal can be successfully crushed on the locomotives itself.

The new boiler designs will require feed water free from scale-forming matter, and for this reason the proper preparation beforehand of the water in water-treating plants becomes necessary. It will even be necessary for the boilers to be fed as far as possible with condensation water, and this implies that the locomotive will have to be fitted with such apparatus as coolers, fans and pumps for condensing the steam.

The weight of the locomotive is particularly unfavourably affected by the large quantity of feed water which has

to be carried. The taking on of fresh supplies of water causes stops of more or less long duration, and these prolong the time for the journey which has been cut down by instituting higher running speeds at considerable expense. At the same time the long distances between the commercial stopping points, which at present cannot be subordinated to the needs for filling up with fresh supplies of water, cause a greater quantity of water to be taken more often than the length of the trip appears to justify. The practice of picking up water from troughs placed between the rails is necessarily reserved for those countries where the climatic conditions are more favourable than they are in Germany, and therefore the recovery of water by condensing the steam appears to become essential for long non-stop runs. Immediately the principle of the recovery of water by condensation is admitted, it is also rational to take advantage of the increase in efficiency offered by the vacuum.

The power required to haul a train of 250 to 300 t. (246 to 295 Engl. tons) at the speed of 150 km. (93 miles) per hour and to accelerate it up to this speed, is very high, and as a result the fuel consumption is considerable on long non-stop runs. For example, the coal capacity of the largest tender, the 5T.37, attached to the types of locomotives at present in service, is insufficient for a run of 500 km. (342 miles). It, therefore, becomes indispensable to reduce as far as possible the tractive effort necessary, and also to get the last ounce out of the coal, that is to say, the work the boiler with high efficiency and to raise the fall in temperature in the steam as much as possible, which leads to the adoption of vacuum and condensation. In adopting these improvements, it is not advisable to seek to realise small heat gains, representing a few units per cent, by fitting complicated arrangements or devices which may necessitate frequent repairs.

The most efficacious means of red

ing the tractive effort at high speeds is to fit the vehicles with streamlined casings. The trials of three new locomotives of the series 03, namely : The first non-streamlined (standard type); the second locomotive 03 154) with streamlined casing over the motion, and with rounded smokebox front; the third (locomotive

03 193) completely streamlined, which were carried out by the Grunewald locomotive testing division at a uniformly maintained speed, shewed the following powers (at the drawbar, for a boiler production of 57 kgr./m²/h. (11.7 lb. per sq. ft. per hour) (figure admitted as the limit) :

Speeds {	km./h.	100	120	140
	m. p. h.	62	75	87
03 (standard type)		1 260	1 075	800 H.P.e.
03 154		1 375	1 250	1 015 H.P.e.
03 193		1 455	1 365	1 185 H.P.e.
Gain due to partial streamlining		115	175	215 H.P.e.
		9.1 %	16.2 %	27.0 %
Gain due to complete streamlining.		195	290	385 H.P.e.
		15.5 %	27.0 %	48.2 %

This power gain depends, of course, only on the shape of the locomotives, and not on the power for which they were constructed. Consequently, it will be found, as regards locomotives of lower or higher power, that immediately they have the same shape and the speed is the same, they have a power gain which is almost equal in H. P., but not in the power percentage.

A thermal gain of about 30 to 40 H. P., which was ascertained by comparing the indicated horse power of the streamlined locomotive with that of the non-streamlined locomotive, is attributable, not to the decreased resistance to the air, but to the reduction in the heat losses by radiation, particularly as regards the cylinders.

Complete streamlining makes the motion less easily accessible. It becomes very difficult for the enginemen to examine and oil the bearings during short stops. The time necessary for the operations carried out before locomotives go into service, and afterwards, is prolonged by reason of the presence of the streamlined casing, at least in its present type. Finally, the repairs and maintenance of the motion and its bearings require more time and labour. Nevertheless, the gain in power due to the complete streamlining, particularly for speeds above 100 km. (62 miles) per

hour, outweighs the economies which are obtained by the adoption of feed water pre-heating, and superheating. In normal service where it often happens that locomotives also work at low speeds, especially on suburban lines close to large cities, the 03 locomotive, completely streamlined, which like the standard non-streamlined locomotive of the same class, was booked for hauling long-distance corridor trains at a maximum speed of 140 km. (87 miles) per hour, as well as at the speed of a normal express, shewed, according to statistics taken over one year, a fuel saving of 11.7 % on the basis of the locomotive-miles, and 15.2 % on the basis of locomotive-ton miles, a saving which justifies the increased expenditure entailed by the fitting and maintenance of the streamlined casings, and justifies the locomotive engineer in resigning himself to accept certain disadvantages. All innovations give rise to difficulties in their early stages, as was the case when steam superheating and feed water pre-heating were introduced. The defects which are still inherent in streamlining will be overcome as time passes.

As regards the aspect of completely streamlined locomotives, everybody will become accustomed to them, as they have done to the appearance of modern automobiles. But here, also, it will doubt-

less be possible to conciliate the beauty of the shape with the most efficient arrangement of lines and contours.

The riding of the new 05 locomotives at high speeds has surpassed all expectations. On straight stretches, the long guiding produces very gentle running. But when a locomotive enters a curve, the guiding effected by the leading bogie does not fulfil all conditions, as the carrying pairs of wheels only follow the locomotive in the new running direction because of the action of the centering forces exerted by the weak bogie side check springs. It is the flange of the first coupled pair of wheels which is called upon to absorb the main part of the guiding pressure. This pressure, which depends on the speed, may reach very high values. The degree of solidity of the wheel centre with the axle is moreover put to the test by this pressure, under conditions which are all the more favourable as the diameter of the wheel is greater. The violent pressures resulting from hammer blow also constitute a very undesirable supplementary load for the crank axles, especially for two-throw crank axles. It was only by means of their vibration recording van that the German Railways were able to establish this fact; and, as testified by Mr. CHAN in an article published in the *Revue Générale des Chemins de Fer*, entitled: « Transverse stresses exerted on the track by the P.L.M. Railway Company's locomotives 221A and 231D », these violent guiding pressures to which the first coupled pairs of wheels of locomotives are subjected, have also been noticed in France. It will therefore be necessary, in order to relieve the pressure on these pairs of wheels, to increase the guiding pressure on the carrying pairs which are the first to meet the curve in the track; and as this pressure on the carrying pairs of wheels is exerted at a much greater distance from the centre of gravity, it is much more effective.

On account of the high pitch of the centre of gravity of steam locomotives, it

was found incumbent to impose a lower limit for the maximum speed on curves than is the case with fast railcars.

Whilst it is necessary, as far as possible, to make the carrying wheels larger than 1 m. (3' 3 3/8") in diameter, on account of the stress to which the tyres are subjected, the effect of arranging large diameters for the driving wheels is to increase to a serious extent the unsprung masses of the locomotive.

It will be advisable to carry the tenders on bogies only, and to avoid the use of fixed axles.

The piston-driven mechanism of the present type has stood up very well to the considerable stresses which result from high-speed running. Nevertheless, two-cylinder motions, with their unbalanced masses, cause supplementary stresses and shocks to be communicated to almost all parts of the locomotive with an adverse effect on the maintenance costs. On three-cylinder locomotives, the balancing of the moving masses is, it is true, appreciably better than on two-cylinder locomotives, but the inspection is difficult of access. Moreover, the three-cylinder engine, also, transmits a large proportion of its stresses through the frame, which necessarily becomes distorted under the action of the stresses.

The Stephenson type boiler easily lends itself to the distortion of its supports. Modern boilers built in several sections undoubtedly are more sensitive in this respect.

At high speeds, the reciprocating masses have a very injurious effect on the bearings, as soon as the regulator is closed, i. e., when coasting, the cushioning formed by the compression of the steam and the pre-admission is lacking to steady the piston. The high pressures and rapid pressure variations which are thus produced very quickly cause the bearings to suffer, and entail the regulator being opened, even when coasting, at speeds exceeding 120 km. (75 miles) per hour. The throwing of the engine out of gear

ing coasting in consequently to be recommended.

Long connecting and coupling rods which are subjected to severe stresses, often give rise to trouble in service, even on slow-running locomotives; their use should, as far as possible, be avoided on locomotives being built for very-high speed work.

Complete streamlining has become indispensable for locomotives hauling passenger trains, the outside motion also becomes inaccessible, and therefore the examination, maintenance and repair of these parts are rendered more difficult. Unlike on locomotives of the standard type, the streamlined casing prevents the dust from the brakes getting away, and dust may cause trouble in non-lubricated axleboxes, as well as in the rod ends, but more particularly on the overhead guides. For high-speed running, efficient and reliable lubrication is consequently imperative, and it must be recognised that in this respect, there is plenty of room for improvement on locomotives. This is especially the case with regard to the lubrication of the cylinders which has not yet been satisfactorily solved. The means for rendering the cylinders dust free, and for preventing oil leaks, are still conspicuous by their absence.

The oil thrown off when a locomotive is running soils not only the standard locomotive itself, but also the coaches, and in particular obscures the vision through the cab windows. This thrown-off oil ricochets from the locomotive streamlined casing on to the tyres, rails and brake blocks; and as it is drawn away by the air-draughts under the wheels, it considerably reduces the friction between the wheels and the rails, especially when starting and braking. The lubricators have to be refilled after very short runs. It often happens that the locomotive has to supply oil to the brasses at intermediate stops, because the limited quantity of oil has proved insufficient. Motor vehicles are capable of

doing 2 000 km. (1 250 miles) and more without having to bother about the lubrication. Locomotive engineers will have to make an effort to introduce on locomotives the progress which has come nowadays to be accepted as normal on other means of transport. As a remedy for lubrication troubles, roller bearings and needle-valve lubricators are recommended, because the manufacturers have necessarily set the rate of oil feed with a fine degree of accuracy. Up to the present time, roller bearings have not given rise to any troubles. The future will shew whether they can also be used for the inside boxes of driving and coupled pairs of wheels, and whether they will be capable, in the long run, of withstanding the violent lateral shocks, which, although only of short duration, reach the value of the vertical load. Roller bearings fitted on driving and coupled pairs of wheels unfortunately mean an addition to the unsprung masses. A problem which remains particularly difficult of solution is the lubrication of the slidebars on streamlined locomotives, which, as they are located behind the cylinders, are not cooled by the air and easily gather the dust which results from the braking operations.

In order to avoid the difficulties which arise at high speeds with the standard driving mechanism, on streamlined locomotives, the principle of individual drives for the axles might be adopted by fitting high-speed running steam engine units on lines similar to the traction motors used for driving the axles of electric locomotives. These drives could be completely enclosed, and consequently made dustproof and better lubricated by an oil circulating system. As the play in the springs, at least on a certain number of the types proposed, has no influence on the piston stroke, and as the piston clearances may be reduced, it will be possible to utilise, in the cylinders, the greater pressure drop, and therefore to build a more economical locomotive. By incorporating rationally designed

driving mechanisms, we shall be able to reduce to a minimum the unsprung masses on the driving pairs of wheels, and avoid the use of counter-balance weights in the wheels. The frames will be relieved of the severe stresses produced by the motion now used and will be of much lighter construction. Another advantage that may be looked for is that it will be possible for individual-drive engine units which break down to be easily replaced by units in good running condition.

The problem of individual axle drives is at present being gone into very closely in several countries. German locomotive designers, for instance, have been studying this question and are seriously trying to find a solution for it. We may mention in this respect that a very remarkable article by Friedrich WITTE, on individual axle drives for steam locomotives, was published in *Glaser's Annalen*, in the number dated 1st July, 1937.

Another method of propulsion, which appears particularly suitable for high-speed locomotives working long-distance runs, is perhaps the steam turbine. With the steam turbine, the unbalanced disturbing masses can be completely eliminated. Besides offering a very advantageous use of the temperature drop, it produces, if a condenser is added to it, an oil-free feed water which is suitable for modern closed circuit boilers. But along with the main turbine, a starting turbine and a back-running turbine, with cooler, pumps, exhausters and gear transmissions, are necessary and introduce a very large assortment of parts on to the locomotive. Moreover, it will not be possible to do away with the coupling rods, unless, in this case also, individual drives for the axles are adopted, and this would make the locomotive still more complicated and adversely affect its heat balance.

Boilers of large power undoubtedly hamper the driver's view of the track when he is standing in a cab fixed be-

hind the engine, and compels him to cross the cab when the locomotive is taking curves turning off to the left. A cab arranged in front of the locomotive as on railcars and electric locomotives would give the driver a better view of the track, and would enable him to observe the signals more easily; and by these points would certainly contribute to greater safety in service. This position of the cab will therefore have to be adopted for high-speed locomotives in preference to the rear cab.

On large locomotives, the work of the fireman absorbs a very large proportion of the fireman's activities, and for this reason he can only take a small share in the work of watching the signals. The quantity of coal fed on to the grate, and consequently the power developed by the locomotive, depends on the physical capacity of the fireman. It is therefore important that large locomotives shall, far as possible, be independent of the fireman's physical capacity, and hence the necessity of resorting to mechanical stokers. Grates of the standard type do not permit locomotives, unless the grate is of good quality, to do more than 100 km. (185 to 250 miles), at the end of which the fire has to be cleaned out, and this means a change of locomotive. From this point of view also, the steam locomotive leaves room for improvement.

We have set out in the foregoing a large number of conditions and desiderata which the locomotive designer must take into consideration, especially if he attaches importance to the use of steam locomotives for high speeds. The effect of these innovations will be to increase the number of parts entering into the construction of the locomotive. Nevertheless, in spite of this, no sacrifice should be made as regards the reliability of the locomotive in service, and everything must be done to make the need for repairs less frequent than in the past. It is to be hoped that the German locomotive building industry will solve these problems in the near future.

NEW BOOKS AND PUBLICATIONS.

636. 255 (.494)]

HARTMANN (Georges), licencié ès sciences commerciales. — **Les tarifs actuels des Chemins de fer suisses pour le transport des marchandises agricoles et des animaux vivants** (*Present day Swiss railway rates for the transport of agricultural produce and livestock*). Thesis for the degree of Doctor of Political Science and Economics, presented to the Faculty of Law at the University of Fribourg. (177 typewritten pages with many tables.) — Price : 7 francs, Swiss currency. (On sale at the author's adress : Rue du Temple, Fribourg, Switzerland.)

We had the opportunity of perusing this elaborate work. Without in any way trying to sum it up, we should like to give some idea of its character and scope.

As the title indicates, it relates to the Swiss rates for the transport of agricultural produce and livestock. In the first chapter the author gives the structure of these rates in detail. Elsewhere he explains the circumstances which determined it and says how such rates suit the needs of the railway's clients and are in conformity with the railway policy. He also indicates the modifications due to the economic crisis and competition with other methods of transport. Finally he reports the services the railway has rendered to agriculture, stressing its role as a public service.

Mr. HARTMANN has divided his thesis into two parts, to one of which he has given a technical character; it is entitled : *Character and nature of the rates*, whilst the other comes rather under the heading of economics and is called : *Reasons and importance of the rates*.

Each part consists of two chapters divided up into sections.

In the first chapter, he attempts to give a complete definition of the rates; then goes on to examine all the conditions under which they apply, grouping them according to their economic, geographical, and technical characteristics.

In the second chapter, he explains the structure of the Swiss rates, on the one hand for the transport of agricultural produce, and on the other for the transport of livestock. He deals in turn with ordinary rates and exceptional rates.

Generally speaking the rates are differential, and in the case of slow goods, consignments in full wagon loads are rated according to a classification in four groups depending in principle on the value, each group having two series of rates based on a minimum weight.

The second part is the longer; the first chapter : Reasons for the rates, has three sub-sections : (1) *the creation of rates according to considerations related to the cost of transport*, (2) *the creation of rates according to the special financial needs of the Swiss railways*, and (3) *the creation of rates according to considerations of general interest by the Swiss railways as regards agricultural economics*.

The author discusses the limits between which the rates may vary. He then analyses the effects of road competition on the railway traffic and receipts, showing the steps taken by the Swiss Federal Railways as regards rates and organisation, and the results obtained. He also deals casually with competition from other railways, that of foreign lines, navigation and airways. As regards the assistance given to agriculture, he reports at length the measures by which the Swiss Federal Railways have endeavoured to assist the development of agriculture, especially by means of special rates.

The last chapter deals with the importance of the rates for the national agriculture and for the Swiss railways.

The author studies, first of all from the point of view of agricultural economics, in the light of the statistics available, the effect of the cost of transport on the cost of agricultural produce, on

the possibility of finding openings for it, and the influence of this cost on consumption and on agricultural production. Analysing then the variation in railway traffic during several years, and during one and the same year, he considers how, and to what extent, rating

measures can stimulate the traffic and improve the receipts.

A very complete bibliography informs the reader of the sources from which the author has taken various information, rather, as he says, found certain of starting points. E. M.

[636. 25]

LAMALLE (U.), Ingénieur Civil des Mines, A. I. Lg., Assistant General Manager of the Belgian National Railways Company. — **Cours d'exploitation des chemins de fer** Tome II: **Exploitation technique. Signalisation** (*Railway operating course. Vol. II. Technical operation. Signalling*), 2nd edition. — 1938, Louvain, Librairie Universitaire Ch. Uystpruyst, Publisher.

This volume follows that dealing with *track laying on curves*, reviewed in the September, 1938, number of this *Bulletin*. It deals with signalling chiefly from the point of view of principles, constructional details and design being a more special subject not entirely within the scope of the title of the book.

There are four chapters entitled: Semaphore and disc type signals, day-light signals, colour-blindness and locomotive cab signalling.

In the first, the author explains the features of the old Belgian two-position signalling and the new three-position system.

The second chapter finds its justification in the extended use of day-light signalling in recent years. As is well known, such signalling has been given a great impetus by the use of automatic block working, the relays of which are readily used to control the signal lamp circuits, but it has also been applied in the absence of automatic block in particular in Belgium, on both a steam-operated line and on an electric line, whereon it offers certain advantages.

The author investigates in turn the principles of the apparatus employed and the various problems raised by day-light signals: current supply, lamp lighting control, anti-phantom devices, dispersion and focussing of the light-beams, and operation.

Railway signalling being mostly based on the correct perception of colours, it is easy to understand the danger which

would arise from the presence on the foot-plate of persons having defective colour vision. Dealing with colour blindness, the author expounds the principles underlying the methods followed for detecting defects of this particular kind, and discusses their practical value.

The fourth subject dealt with has given rise to much controversial argument. A considerable amount of cab signalling is now in use and there are numerous different systems. In addition to the question of what kind of indications should be given to the driver there is also the fundamental one of how to transmit the required effect from the ground apparatus to the locomotive. The author explains the distinction found, with electric contact system between open and closed circuit working, mentioning the Great Western Railway apparatus after those in service elsewhere, particularly in France and Belgium.

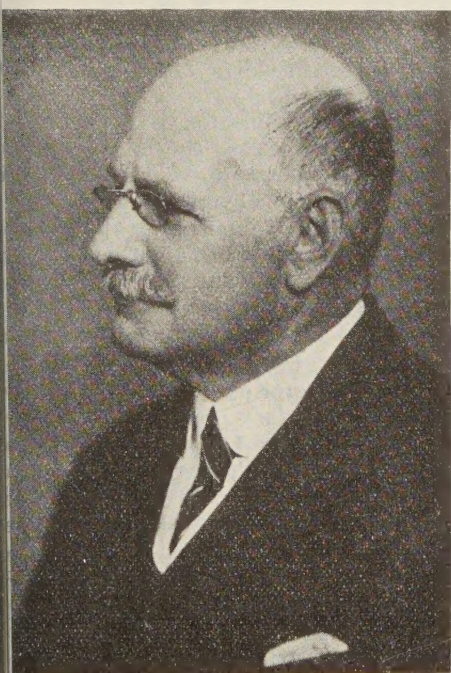
Inductive systems are represented by a description of the Signum system adopted by the Swiss Federal Railways and the dead-man's apparatus on electric locomotives.

Finally the author explains what is understood by « continuous » cab signalling, for which devices are now in existence and which, keeping the driver informed at every moment of the condition of the track ahead of him, allow, theoretically at least — of dispensing with the ordinary fixed signals. E.

OBITUARY.

Sir Henry FOWLER, K.B.E., LL.D., D.Sc.,

formerly Assistant to Vice-President for Research and Development, London Midland & Scottish Railway, and Member of the Permanent Commission of the International Railway Congress Association



We deeply regret to record the death of Sir Henry FOWLER, K. B. E., formerly Chief Mechanical Engineer, later Assistant to Vice-President for Research and Development, London Midland and Scottish Railway.

Sir Henry was born on July 29th, 1860, and educated at Evesham and at

the Mason Science College, Birmingham, and was apprenticed at the Horwich Works of the Lancashire and Yorkshire Railway, being subsequently appointed Assistant, then Chief of the Testing Department, and finally Gas Engineer of the Company. Whilst at Horwich, he was closely associated with the work of the Railway Mechanics' Institute, first as a student, and then as a teacher.

In 1900, Sir Henry left the Lancashire and Yorkshire Railway to take up the position of Gas Engineer on the Midland Railway; in 1905, he became Works Assistant and in 1907, Works Manager, Derby. In 1909, he was appointed Chief Mechanical Engineer of the Midland Railway, which position he held until the formation of the London Midland and Scottish Railway in 1923, when he was made Deputy Chief Mechanical Engineer for the whole undertaking, as well as Mechanical Engineer for the Midland Division. In 1925, following the retirement of Mr. George HUGHES, his former chief at Horwich, he was appointed Chief Mechanical Engineer, London Midland and Scottish Railway, which position he held until the end of 1930, when he became Assistant to the Vice-President for Works (Research and Development). He retired from this position in 1933, being elected the next year by the Ministry of Transport as Chairman of a Committee appointed to investigate the

question of noise in connection with mechanically propelled vehicles.

In 1907, Sir Henry had visited America, where he gained much experience in railway and mechanical matters.

During the War, he was appointed Director of Production, Ministry of Munitions, in 1915, Superintendent of the Royal Aircraft Factory in 1916, Assistant Director General of Aircraft Production in 1917, and subsequently held various other positions under that Ministry from 1918 to 1919.

He was created C. B. E. in 1917, and K. B. E. in 1918, for his services in this latter connection.

Sir Henry was a full member of the Institution of Civil Engineers and a member of Council of the Institution. Papers read before the Institution gained him the Miller Prize, the Telford Premium, the Watt Medal and the Webb Prize.

In 1922, he collaborated with Sir Nigel GRESLEY (then Mr.) in presenting to that Institution a paper on the results of brake trials with long goods trains.

He was President of the Institutions of Mechanical Engineers (1927), Locomotive Engineers (1912-14), Automobile Engineers (1920-21), of the University of Birmingham Engineering Society (1912-14), of the Engineering Section of the British Association for the Advancement of Science (1923), and the Institute of Metals (1932). He was also a member of the Institute of Transport, and was awarded the Railway Engineering Gold Medal by the Council of that Institute (1929-30). He held the honorary degree of LL. D. from the University of Birmingham, and of D. Sc. from

the University of Manchester, and he was the first honorary graduate of the Manchester College of Technology.

Sir Henry had been a member of the Permanent Commission of the International Railway Congress Association since 1925, and took a very active part in the London (1925), Madrid (1930) and Cairo (1933) Sessions, being in each case appointed assistant General Secretary, and presenting reports on the following subjects :

In 1930 — Question VI : Investigation into the static and dynamic stresses in railway bridges (in collaboration with Mr. G. ELLSON);

In 1933 — Question III : Methods to be used to increase the mileage run by locomotives between two repairs including lifting. Sir Henry also drew up the special report summing up the three reports presented on this Question.

Already in 1922, at the Rome Session he read a very interesting note on the utility of studying the question of the use of liquid fuel in locomotives.

In collaboration with Mr. BARRIOL, General Secretary of the Paris Statistics Department, Sir Henry audited the accountancy of the Association for the periods ending with the London (1925), Madrid (1930) and Cairo (1933) Sessions.

Thanks to his ceaseless activity and cheerful disposition, Sir Henry was held in very high esteem by his colleagues of the Permanent Commission, who will keep the best of remembrances of him.

We wish to convey our sincerest sympathy to his family.

The Executive Committee.